Courses on the ENVIRONMENT

A Student Guide to University of Minnesota
Courses on Environmental Issues on the Twin Cities Campus

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CONTENTS

GENERAL INFORMATION

Courses on the Environment: A Student Guide to University of Minnesota Courses on Environmental Issues on the Twin Cities Campus, 1992-1993 is a supplemental guide to official University bulletins of the various colleges, schools, and institutes of the University of Minnesota. There are 358 courses in 49 different departments listed in this 1992-1993 guide.

FEATURES OF THE 1992-1993 GUIDE

I. Academic Programs

Formal academic programs which focus on a broad range of environmental issues and use an interdisciplinary approach are listed in a new section that appears in the front of the guide. These programs are offered by several colleges, schools, and institutes at the University, and generally require a combination of courses from different fields of instruction.

Degrees offered are at the bachelor, master, and doctoral levels, while some programs offer minors and concentrations. If some programs have been missed, we ask that you bring them to our attention.

Information given for each program includes its name and where it is located, the name of a faculty contact person, the number of credits and other requirements, and a brief description.

Many departments listed in part III of this guide offer degrees with an environmental studies emphasis within their own fields of instruction. To explore the full extent of degree programs and course offerings in a specific department, consult the appropriate college bulletin.

In addition, there are programs in the College of Liberal Arts and University College in which students can design their own environmental studies major. For information about CLA's special learning opportunities and individualized programs contact the Office for Special Learning Opportunities, 220 Johnston Hall (624-7577). For information about UC's degree programs contact the Inter-College Program, 7 Wulling Hall (624-2004), or the Program for Individualized Learning, 201 Wesbrook Hall (624-4020).

II. Courses Listed by Subject Area

This section is a subject index where courses are arranged by broad subject areas. It is designed to help students find courses of interest in various colleges and departments. This subject area listing will be of special interest to students who wish to pursue an interdisciplinary area of environmental study. While some courses are obviously found in a certain department, it is difficult to be aware of all the courses which pertain to a particular topic because they are offered by so many different departments and are listed in so many different University bulletins.

New Subject Areas: Two new subject areas have been added to the 1992-1993 guide. They are Agriculture with nineteen courses from seven departments, and International Issues/Global Resources with thirty courses from nineteen departments. There are twenty-two subject areas in total. All 358 courses described in part III are listed in one or more subject areas in part II.

III. Courses Listed by Department

Part III lists courses by department and gives the name of a contact person who is prepared to advise students desiring more information. For each course, it lists credits, prerequisites, registration information, and course description. Part III can serve as a guide to students pursuing an environmental studies emphasis within a given departmental major or minor.

New Departments: Seven departments are listed for the first time in this 1992-1993 guide. They are: Agronomy and Plant Genetics; Animal and Plant Systems; Biochemistry; Design; Design, Housing and Apparel; Honors Colloquia; and Housing.

New Courses and Deleted Courses: Forty-seven courses have been added to this year's guide. Eighteen are from the seven new departments, and twenty-nine are new courses in departments included in previous guides. All are marked "✿ **new**" at the beginning of the course description. Twenty-nine courses have been dropped.

Registration through Day School and/or Extension Classes: Registration for courses at the University of Minnesota is possible through day school and/or Extension Classes, depending on the course. There are three types of courses, and the type for each course is noted at the end of the line giving credit and prerequisites information.

1. **Day class.** A course for which registration is possible only through day school.

2a. **Joint Day/Extension class.** A single course for which registration is possible through both day school and Extension Classes. The course usually meets at 3:30 p.m. or later and is listed in both the daytime *Class Schedule* and the *Extension Classes Bulletin.*

2b. **Joint Day/Extension class: refer to daytime *Class Schedule*.** A single course for which registration is possible through both day school and Extension Classes. The course usually is offered during the day and is listed in the daytime *Class Schedule* but not in the *Extension Classes Bulletin.*

3. **Extension class.** A course for which registration is possible only through Extension Classes. It usually meets in the evening.

Please note that some courses are offered through *both* day school *and* Extension Classes. These are two separate courses which meet at two different times. Such courses are noted as **"Day class and Extension class."**

There are certain requirements and restrictions for students registering for both day school and Extension classes, and it is suggested that students consult with their college offices and/or Extension Classes.

IV. Centers

Centers at the University of Minnesota that participate in environmentally-related activities are listed in this section. These activities often include research in which interested students and faculty members might become involved. In some cases students may obtain credit for work completed in such activities.

V. Libraries

The libraries section lists University of Minnesota libraries and collections that have material on environmental issues. Other Twin Cities libraries with material on the environment in their collections are also listed.

Course Symbols

§ Credit will not be granted if equivalent course listed after this symbol has been taken for credit.

¶ Concurrent registration allowed with course listed after this mark.

Consent of instructor is required for registration.

Δ Consent of department or school offering the course is required for registration.

H Honors course.

I. ACADEMIC PROGRAMS

Majors, Minors, and Concentrations for Bachelor's, Master's, and Doctoral Degrees

AGRICULTURE
B.S. with Minor in SUSTAINABLE AGRICULTURE

Agronomy and Plant Genetics
College of Agriculture
Donald L. Wyse, 411 Borlaug Hall, 625-7064

Credits: 30 credits

Requirements: For the minor, the following three courses totaling 12 credits are required: Agro 5030—Weed Control, AnPl 5060—Insect Pest Management, Ent 5320—Ecology of Agriculture. The remaining 18 credits must be taken from at least three of the following four areas: 1) pest control; 2) crops, soils, and water; 3) agricultural economics; and 4) integration of agriculture and society.

Description: While all agriculturally oriented majors of the College of Agriculture consider issues of sustainability of energy and resource intensive agricultural systems, the sustainable agriculture minor provides a concentration of courses giving students an understanding of scientific, technological, and socioeconomic factors affecting the viability of agriculture. Students examine ecological features of agriculture and work through decision-making case studies involving integrated management of specific agricultural systems. The minor provides a degree of flexibility and individuality through several elective options.

CONSERVATION BIOLOGY
M.S. and Ph.D.

Fisheries and Wildlife
College of Natural Resources
Francie Cuthbert, 320 Hodson Hall, 624-1756

Credits: M.S., 44 credits; Ph.D., 68 credits

Requirements: All master's students must take the core courses and 15 credits of elective courses in the biological and social aspects of conservation biology.

Ph.D. candidates take the core courses and are expected to show competency in both the biological and social sciences. Students develop a program that emphasizes the ecological and social aspects of conservation biology.

Description: The conservation biology program has two complementary aims leading to a unique interdisciplinary program. The first is to provide students with sound graduate training in the biological sciences relevant to the conservation of plants, animals, and ecosystems globally. The second is to expose students to the social, political, and economic sciences that relate to both the recognition and solution of conservation problems. The overall objective of the program is to prepare students to develop solutions or approaches to these problems that are scientifically and environmentally sound and likely to be acted upon or implemented by existing social and political structures.

ECOLOGY, EVOLUTION, AND BEHAVIOR
B.S., M.S. and Ph.D.

College of Biological Sciences
Franklin Barnwell, 109 Zoology, 625-7484

Credits: 180 credits for the B.S. degree

Requirements: For the B.S. degree, in addition to general requirements for graduation from the College of Biological Sciences, there are required and recommended courses in the following groups: community ecology and paleoecology; population and evolutionary biology; organismal biology and physiological ecology; behavioral biology; limnology and ecosystem biology. Field experience in biology (at least 5 credits) at the Lake Itasca Forestry and Biological Station or other field stations is also required.

For the M.S. and Ph.D. degrees, an individual program which will meet the interests and needs of the student is designed.

Description: Ecologists study the evolutionary adaptations of plants and animals to the environment. The ecological perspective encompasses the growth and maintenance of populations and their interactions in communities, and the interrelationships among organisms and physical events in terrestrial and aquatic ecosystems. The behavioral biology perspective deals with adaptation to the environment, mechanisms of behavior, and the evolution of social systems.

ENVIRONMENTAL DESIGN
B.E.D.

Architecture
College of Architecture and Landscape Architecture
J. Steven Weeks, 110 Architecture Building, 624-7866

Requirements: The non-professional Bachelor of Environmental Design degree program in the Department of **Architecture** normally requires two years of pre-environmental design work, acceptance to College of Architecture and Landscape Architecture, and two more years of coursework in introductory professional courses in architecture.

Description: This four-year degree permits students a less extensive study of architecture to prepare for careers in planning, design, development, real estate, or historic preservation without the extra time commitment needed to complete a professional degree.

ENVIRONMENTAL DESIGN
B.E.D.

Landscape Architecture
College of Architecture and Landscape Architecture
J. Stephen Weeks, 110 Architecture Building, 624-7866

Requirements: The non-professional Bachelor of Environmental Design degree program in the Department of **Landscape Architecture** allows students to explore a broad range of environmental courses as well as complete two years of professional courses in landscape architecture.

Description: This four-year degree permits students a less extensive study of architecture to prepare for careers in planning, design, development, real estate, or historic preservation without the extra time commitment needed to complete a professional degree.

ENVIRONMENTAL HEALTH
M.P.H.

Division of Environmental and Occupation Health
School of Public Health
Ian A. Greaves (Head), Marilyn Zappia (Student Coordinator), Box 807 UMHC, 626-0900

Credits: 45 credits

Requirements: For the **Master of Public Health** degree, the course of instruction requires a minimum of 11 months of study which begins in the fall quarter and continues through the following summer sessions. Specialty areas require a two-year curriculum.

Description: This major is designed for general environmental health students and those wishing to focus in environmental toxicology, environmental chemistry, environmental and occupational epidemiology, environmental microbiology, industrial hygiene (including radiation protection), injury prevention, occupational medicine, and occupational health nursing.

ENVIRONMENTAL HEALTH
M.S. and Ph.D.

Graduate School
Ian A. Greaves (Head), Marilyn Zappia (Student Coordinator), Box 807 UMHC, 626-0900

Credits: 44 credits for M.S. degree

Requirements: For the **Master of Science** degree, the course of instruction requires a minimum of 11 months of study which begins in the fall quarter and continues through the following summer sessions. Specialty areas require a two-year curriculum. Candidacy for the Ph.D. program requires completion of the master's degree (or the equivalent) in environmental health.

Description: Emphases include environmental epidemiology, environmental health chemistry, environmental toxicology, general environmental health, hazardous waste management, industrial hygiene, injury prevention and control, institutional environmental health, occupational epidemiology, occupational health nursing, occupational injury prevention and safety, and occupational medicine.

NATURAL RESOURCES AND ENVIRONMENTAL STUDIES
B.S.

College of Natural Resources and College of Agriculture
John V. Bell, 135 Natural Resources, 624-6768

Credits: 180 credits

Requirements: All students take the core curriculum of required courses plus at least 24 credits in an area of concentration: water resources, soil resources, environmental issues and planning, resources and environmental protection, resource assessment, and waste management.

Description: This program is for students interested in interdisciplinary study of the environment and the use and management of natural resources. The curriculum enables students to become knowledgeable and articulate about natural resource and environmental issues and to be sensitive to the many interrelationships between human and natural systems. Students will gain an appreciation of the important and evolving role of natural resource and environmental management in local, regional, national, and international communities.

Programs can be designed to: 1) gain an understanding of the interaction between natural resources and the functioning of modern society, 2) learn about the significant social and environmental roles that can be played by natural resources located throughout the nation and the world, 3) prepare for careers in public and private organizations that are responsible for planning the use and management of natural resources and protection of the environment, 4) learn about subjects that will prepare for positions in fields such as environmental assessment, resource inventory, natural resource planning, environmental protection, sustainable development, policy analysis, and waste management, 5) develop appropriate background for the pursuit of graduate study.

PUBLIC AFFAIRS
M.A. with concentration in TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY

Hubert H. Humphrey Institute of Public Affairs
D.E. Abrahamson, 230 Humphrey Center, 625-2338

Credits: 64 credits

Requirements: For the **Master of Arts** degree, students complete the core curriculum of six courses, at least 18 credits in a primary concentration, 12 credits in a secondary concentration, electives, the Plan B project, and an internship of at least three months.

Description: Courses explore the relation of science and technology to society and the policy process, the role of energy in contemporary societies, natural and physical environmental systems, and environmental aspects of technological innovation.

The M.A. degree offers broad-based education for careers and lives in the public interest. The curriculum recognizes that graduates will work in government, business, and the independent sector in leadership, management, analytical, and advocacy capacities.

PUBLIC AFFAIRS
M.P. with Concentration in TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY

Hubert H. Humphrey Institute of Public Affairs
D.E. Abrahamson, 230 Humphrey Center, 625-2338

Credits: 64 credits

Requirements: For the **Master of Planning** degree, students complete the core curriculum of six courses, at least 18 credits in a single area of concentration, planning courses (in place of a secondary concentration), electives, the Plan B project, and an internship of at least three months.

Description: Courses explore the relation of science and technology to society and the policy process, the role of energy in contemporary societies, natural and physical environmental systems, and environmental aspects of technological innovation.

The M.P. program emphasizes training in the basic philosophy, theory, and methods of planning. Five important types of planning are covered: 1) policy planning, 2) resource allocation planning, 3) regulatory planning, 4) implementation or program planning, and 5) project management or operations planning.

WATER RESOURCES
Minor for M.S. or Ph.D.

Graduate School
Water Resources Minor, c/o Water Resources Research Center
Patrick L. Brezonik, Suite 302, 1518 Cleveland Ave., St. Paul Campus, 624-9282 or 625-0866

Credits: M.S., 13 credits; Ph.D., 21 credits

Requirements: An introductory seminar on water resources management (2 credits), two core courses (6-9 credits), and elective courses are required. At least 11 credits must be selected from one of these four categories for the master's and two for the doctoral degree: 1) biological sciences, 2) earth and climate sciences, 3) engineering, and 4) social sciences.

Description: This is an interdisciplinary structured program with faculty drawn from the colleges of Agriculture, Biological Sciences, Liberal Arts, Natural Resources, Humphrey Institute of Public Affairs, and the Institute of Technology.

WILDLIFE CONSERVATION
M.S., Ph.D., and Minor

Fisheries and Wildlife
College of Natural Resources
Francie Cuthbert, 320 Hodson Hall, 624-1756

Requirements: Plan A is recommended for the master's degree; Plan B is available under special circumstances. Students must become familiar with factors underlying wildlife population and habitat ecology, techniques in management, and the functioning of management agencies. Academic work includes courses in animal ecology, wildlife management, and statistics.

For the doctoral degree, programs include basic wildlife biology and development of analytical skills, and one or more areas of specialization.

A graduate minor is available for students majoring in other fields. Programs are designed according to individual student needs while insuring a comprehensive exposure to wildlife ecology and management.

Description: The wildlife conservation graduate program is an applied program emphasizing resource management and conservation problem-solving. For the M.S. degree, emphasis is on wildlife biology and related areas in ecology, animal behavior, and physiology as these relate to resource management and conservation problem-solving. For many students, the M.S. is a terminal degree leading to employment with government resource management agencies. For the Ph.D. program, emphasis is on basic biology and ecology with concentrated work in independent, original research generally relating basic science to management/conservation challenges.

II. COURSES LISTED BY SUBJECT AREA

AGRICULTURE

Agricultural and Applied Economic

AgEc 5710. U.S. AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.

AgEc 5730. EUROPEAN AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.

Agricultural Engineering

AgEn 3052. ENGINEERING PRINCIPLES OF SOIL-WATER-PLANT SYSTEMS.

Agricultural Engineering Technology

AgET 5027. APPROPRIATE TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT.

Agronomy and Plant Genetics

Agro 3010. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.

Agro 5001. SUSTAINABILITY, ECOLOGY, AND AGRICULTURE: AN INTERDISCIPLINARY INQUIRY.

Agro 5030. WEED CONTROL.

Agro 5070. ECOLOGY OF FIELD CROPS.

Agro 5110. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.

Agro 8030. MODE OF ACTION OF HERBICIDES.

Agro 8040. WEED BIOLOGY.

Agro 8070. COLLOQUIUM IN AGROECOLOGY.

Animal and Plant Systems

AnPl 3010. ENVIRONMENT AND WORLD FOOD PRODUCTION.

AnPl 5060 INTEGRATED MANAGEMENT OF CROPPING SYSTEMS.

Entomology

Ent 1005. ECONOMIC ENTOMOLOGY.

Ent 5210. INSECT PEST MANAGEMENT.

Ent 5280. LIVESTOCK ENTOMOLOGY.

Ent 5320. ECOLOGY OF AGRICULTURE.

Rhetoric

Rhet 3375. HUMANITIES: AGRICULTURAL HERITAGE.

CLIMATOLOGY AND METEOROLOGY

Forest Resources

FR 3103. METEOROLOGY AND CLIMATOLOGY FOR RESOURCE MANAGERS.

General College

GC 1111. SCIENCE IN CONTEXT: WEATHER AND CLIMATE.

Geography

Geog 1425. INTRODUCTION TO METEOROLOGY.

Geog 3421. CLIMATOLOGY.

Geog 5424. APPLIED CLIMATOLOGY.

Geog 5441. QUATERNARY LANDSCAPE EVOLUTION.

Geog 8420. SEMINAR: CLIMATOLOGY.

Geology and Geophysics

Geo 8262. QUATERNARY PALEOECOLOGY AND CLIMATE.

Physics

Phys 5461. PHYSICS AND CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE.

Soil Science

Soil 1262. INTRODUCTION TO METEOROLOGY.

Soil 5240. MICROCLIMATOLOGY (SOILS).

Soil 5424. APPLIED CLIMATOLOGY.

CULTURE, SOCIETY, AND ENVIRONMENTAL PROBLEMS

Anthropology

Anth 5116. ECOLOGICAL ANTHROPOLOGY.
Anth 5117. ANTHROPOLOGY OF RESOURCE MANAGEMENT.

Architecture

Arch 3060. TECHNOS: FORCE, FORM AND ARCHITECTURE.

Business, Government, and Society

BGS 3002. BUSINESS AND SOCIETY.

Civil Engineering

CE 5003. EARTH-SHELTERED BUILDING DESIGN.

Design

Dsgn 3631. INTERIOR DESIGN RESOURCES AND MATERIALS.
Dsgn 3633. LIGHTING DESIGN FOR ENVIRONMENTAL SPACES.

Design, Housing and Apparel

DHA 1101. INTRODUCTION TO THE DESIGNED ENVIRONMENT.

General College

GC 1112. ECOLOGICAL EVALUATION OF ENVIRONMENTAL PROBLEMS.

History of Science and Technology

HSci 3331/5331. TECHNOLOGY IN AMERICAN CULTURE.

Honors Colloquia

HCol 1010. HONORS COLLOQUIUM. FROM VCRs TO PCBs: COMMUNICATING ABOUT SCIENCE.

Housing

Hsg 3463. ENVIRONMENT: HOUSING AND COMMUNITY.
Hsg 5482. THE FAMILY AND ENERGY ISSUES.

Humanities

Hum 3366. LANDSCAPE AND IDEOLOGY, 1600-1875.

Landscape Architecture

LA 1021. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE.
LA 1022. HISTORY OF ENVIRONMENTAL DEVELOPMENT: LANDSCAPE ARCHITECTURE.
LA 1023. HISTORY OF ENVIRONMENTAL DEVELOPMENT: PLANNING.
LA 3001. ENVIRONMENTAL DESIGN: PEOPLE AND ENVIRONMENT.
LA 3002. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES.
LA 8330. CONCEPTS OF LANDSCAPE EVALUATION.

Rhetoric

Rhet 1310. HUMANITIES: THE LAND IN AMERICAN EXPERIENCE.
Rhet 3375. HUMANITIES: AGRICULTURAL HERITAGE.

Sociology

Soc 3551. WORLD POPULATION PROBLEMS.
Soc 3960. ENVIRONMENTAL SOCIOLOGY.

EARTH SCIENCES

General College

GC 1171. PHYSICAL GEOLOGY.
GC 1173. GEOLOGY OF THE NATIONAL PARKS.

Geography

Geog 1401. PHYSICAL GEOGRAPHY.
Geog 5441. QUATERNARY LANDSCAPE EVOLUTION.

Geology and Geophysics

Geo 1001. THE DYNAMIC EARTH: AN INTRODUCTION TO GEOLOGY.
Geo 1012. PLANET EARTH.
Geo 1021. INTRODUCTION TO GEOLOGY LAB: GEOLOGY OF MINNESOTA.
Geo 1111. INTRODUCTORY PHYSICAL GEOLOGY.
Geo 1601. OCEANOGRAPHY.
Geo 3401. INTRODUCTORY MINERALOGY.
Geo 5004. MINERALOGY.
Geo 5108. ADVANCED ENVIRONMENTAL GEOLOGY.
Geo 5201. STRUCTURAL GEOLOGY.
Geo 5251. GEOMORPHOLOGY.
Geo 5261. GLACIAL GEOLOGY.

Geo 5311. GENERAL GEOCHEMISTRY.
Geo 5313. AQUEOUS GEOCHEMISTRY.
Geo 8617. TRANSPORT PHENOMENA IN NATURAL POROUS MEDIA.

ECOLOGY

Agronomy and Plant Genetics

Agro 3010. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.
Agro 5001. SUSTAINABILITY, ECOLOGY, AND AGRICULTURE: AN INTERDISCIPLINARY INQUIRY.
Agro 5070. ECOLOGY OF FIELD CROPS.
Agro 5110. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.
Agro 8070. COLLOQUIUM IN AGROECOLOGY.

Animal and Plant Systems

AnPl 3010. ENVIRONMENT AND WORLD FOOD PRODUCTION.

Anthropology

Anth 5116. ECOLOGICAL ANTHROPOLOGY.

Biochemistry

BioC 5301. ECOLOGICAL BIOCHEMISTRY.

Biology

Biol 5041. ECOLOGY.
Biol 5841. ECOLOGY.

Conservation Biology

CB 8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES.

Ecology, Evolution, and Behavior

EEB 3001. INTRODUCTION TO ECOLOGY.
EEB 3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS.
EEB 5004. DYNAMICS OF GLOBAL CHANGE: QUATERNARY HISTORY OF ECOSYSTEM RESPONSE.
EEB 5008. QUATERNARY ECOLOGY.
EEB 5014. ECOLOGY OF PLANT COMMUNITIES.
EEB 5016. ECOLOGICAL PLANT GEOGRAPHY.
EEB 5606. ECOLOGY OF FISHES.
EEB 5607. ECOLOGY OF ANIMAL PLANKTON.
EEB 5608. ECOSYSTEMS: FORM AND FUNCTION.
EEB 5814. PLANT COMMUNITY ECOLOGY.
EEB 5817. VERTEBRATE ECOLOGY.

Entomology

Ent 5040. INSECT ECOLOGY.
Ent 5250. FOREST ENTOMOLOGY.
Ent 5320. ECOLOGY OF AGRICULTURE.
Ent 8240. COLLOQUIUM IN INSECT ECOLOGY.

Fisheries and Wildlife

FW 1002. WILDLIFE: ECOLOGY, VALUES AND HUMAN IMPACT.
FW 5603. ECOLOGY AND MANAGEMENT OF FISH AND WILDLIFE HABITATS.
FW 5620. GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR FISHERIES, WILDLIFE, AND BIOLOGICAL CONSERVATION.

Forest Resources

FR 3101. NORTHERN FOREST ECOSYSTEMS.
FR 3104. FOREST ECOLOGY.
FR 3107. FOREST ECOLOGY LABORATORY.
FR 5104. FOREST ECOLOGY.
FR 5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS.
FR 5215. FOREST FIRE MANAGEMENT.
FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION.
FR 8104. RESEARCH PROBLEMS: FOREST ECOLOGY.
FR 8105. ADVANCED FIELD SILVICULTURE.

General College

GC 1112. ECOLOGICAL EVALUATION OF ENVIRONMENTAL PROBLEMS.

Geography

Geog 5441. QUATERNARY LANDSCAPE EVOLUTION.

Geology

Geo 5108. ADVANCED ENVIRONMENTAL GEOLOGY.

Landscape Architecture

LA 5119. PLANTING DESIGN: ECOLOGICAL PRINCIPLES/LAND USE CONCEPTS AND IMPLEMENTATION.

Microbiology

MicB 5611. MICROBIAL ECOLOGY.

Natural Resources and Environmental Studies

NRES 3060/5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT.

Plant Biology

PBio 3201. INTRODUCTORY PLANT SYSTEMATICS.

PBio 5811. FRESHWATER ALGAE.

Plant Pathology

PlPa 5102. ECOLOGY OF FUNGI.

PlPa 5106. MYCOLOGY: ASCOMYCETES - FUNGI IMPERFECTI.

PlPa 5107. MYCOLOGY: BASIDIOMYCETES.

Soil Science

Soil 5605. MICROBIAL ECOLOGY.

ENERGY USE

Anthropology

Anth 5117. ANTHROPOLOGY OF RESOURCE MANAGEMENT.

Architecture

Arch 3064-3065. ENVIRONMENTAL MANAGEMENT AND CONTROL.

Business, Government, and Society

BGS 3003. BUSINESS AND THE NATURAL ENVIRONMENT.

Civil Engineering

CE 5003. EARTH-SHELTERED BUILDING DESIGN.

CE 5004. UNDERGROUND CONSTRUCTION ENGINEERING.

CE 5212. TRANSPORTATION PRODUCTIVITY AND ENERGY CONSERVATION.

Design

Dsgn 3633. LIGHTING DESIGN FOR ENVIRONMENTAL SPACES.

Geology and Geophysics

Geo 1005. GEOLOGIC PERSPECTIVES ON ENERGY.

Housing

Hsg 1401. RESIDENTIAL TECHNOLOGY.

Hsg 5482. THE FAMILY AND ENERGY ISSUES.

Mechanical Engineering

ME 5603. THERMAL ENVIRONMENTAL ENGINEERING.

ME 5630. THERMAL ENVIRONMENTAL ENGINEERING SENIOR LABORATORY.

ME 5712. SOLAR ENERGY UTILIZATION.

Natural Resources and Environmental Studies

NRES 1040. NATURAL RESOURCES AS RAW MATERIALS.

Public Affairs

PA 5711. ENERGY POLICY I.

PA 5712. ENERGY POLICY II.

PA 5792. TOPICS IN ENVIRONMENT AND ENERGY POLICY.

PA 8791-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY.

Soil Science

Soil 5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.

ENVIRONMENTAL HEALTH AND POLLUTION CONTROL

Aerospace Engineering and Mechanics

AEM 5687. INTRODUCTION TO ACOUSTICS AND ENVIRONMENTAL NOISE.

Biochemistry

BioC 5301. ECOLOGICAL BIOCHEMISTRY.

Business, Government, and Society

BGS 3019/H3019 TOPICS IN BUSINESS, GOVERNMENT AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.

Civil Engineering

CE 5506. ENVIRONMENTAL WATER CHEMISTRY.
CE 5510. SOLID AND HAZARDOUS WASTE MANAGEMENT.
CE 5515. WATER AND WASTEWATER MICROBIOLOGY.
CE 5540. ANALYSIS OF GROUNDWATER-SOIL POLLUTION ABATEMENT TECHNOLOGY.
CE 8560. SEMINAR: SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING.

Communication Disorders

CDis 5704. NOISE AND MAN.

Environmental and Occupational Health

PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: PRINCIPLES OF ENVIRONMENTAL HEALTH LAW.
PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: POLLUTION CONTROL LAW.
PubH 5151. ENVIRONMENTAL HEALTH.
PubH 5152. ENVIRONMENTAL HEALTH.
PubH 5153. CASE STUDIES IN ENVIRONMENTAL HEALTH.
PubH 5155. ISSUES IN ENVIRONMENTAL AND OCCUPATIONAL HEALTH.
PubH 5158. HEALTH RISK EVALUATION.
PubH 5171. ENVIRONMENTAL MICROBIOLOGY.
PubH 5181. AIR POLLUTION.
PubH 5184. AIR ANALYSIS.
PubH 5186. ENVIRONMENTAL CHEMISTRY.
PubH 5201. RADIATION PROTECTION AND MEASUREMENT.
PubH 5202. RADIATION LABORATORY.
PubH 5212. VENTILATION CONTROL OF ENVIRONMENTAL HAZARDS.
PubH 5239. MICROBIOLOGY OF THE HUMAN ENVIRONMENT: SEMINAR.
PubH 5253. INTRODUCTION: HAZARDOUS WASTE MANAGEMENT.
PubH 5261. GENERAL ENVIRONMENTAL TOXICOLOGY.
PubH 5267. ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY.
PubH 8185. ANALYSIS OF TOXICANTS.

Fisheries and Wildlife

FW 5460. POLLUTION IMPACTS ON AQUATIC SYSTEMS.

Interdepartmental Study

ID 5525-5526. GARBAGE, GOVERNMENT, AND THE GLOBE.

Law School

Law 5885. ADVANCED ENVIRONMENTAL LAW.

Mechanical Engineering

ME 5603. THERMAL ENVIRONMENTAL ENGINEERING.
ME 5609. AIR POLLUTION.
ME 5610. AIR POLLUTION CONTROL.

Plant Pathology

PlPa 5007. AIR POLLUTANTS AND THEIR EFFECTS ON PLANTS.

Sociology

Soc 3960. ENVIRONMENTAL SOCIOLOGY.

FISH AND WILDLIFE

Ecology, Evolution, and Behavior

EEB 5136. ICHTHYOLOGY.
EEB 5606. ECOLOGY OF FISHES.
EEB 5817. VERTEBRATE ECOLOGY.
EEB 5834. FIELD ORNITHOLOGY.

Fisheries and Wildlife

FW 1001. ORIENTATION IN FISHERIES AND WILDLIFE.
FW 1002. WILDLIFE: ECOLOGY, VALUES AND HUMAN IMPACT.
FW 1101. ETHICS AND VALUES IN RESOURCE MANAGEMENT.
FW 3052. INTRODUCTION TO FISHERIES AND WILDLIFE.
FW 3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT.
FW 3600. FISHERIES AND WILDLIFE FIELD TECHNIQUES.
FW 5129. MAMMALOGY.
FW 5455. AQUACULTURE.
FW 5459. PHYSIOLOGY AND BEHAVIOR OF FISH.
FW 5461. THE BEHAVIOR OF FISHES.
FW 5570. AVIAN CONSERVATION AND MANAGEMENT.
FW 5601. ASSESSMENT AND MANAGEMENT OF VERTEBRATE POPULATIONS.

FW 5603. ECOLOGY AND MANAGEMENT OF FISH AND WILDLIFE HABITATS.
FW 5604. FISHERY AND WILDLIFE MANAGEMENT.
FW 5620. GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR FISHERIES, WILDLIFE, AND BIOLOGICAL CONSERVATION.

Forest Resources

FR 3106. IMPORTANT PLANTS: FISHERIES AND WILDLIFE HABITATS.
FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION.

General College

GC 1133. NATURE STUDY.

Small Animal Clinical Sciences

SACS 5330. WILD BIRD MEDICINE.

FOREST RESOURCES

Entomology

Ent 5250. FOREST ENTOMOLOGY.

Forest Resources

FR 1001. FOREST RESOURCES ORIENTATION.
FR 1100. DENDROLOGY.
FR 1200. INTRODUCTION TO FOREST RESOURCES.
FR 1202. FARM AND SMALL WOODLANDS FORESTRY.
FR 3100. IMPORTANT FOREST PLANTS.
FR 3101. NORTHERN FOREST ECOSYSTEMS.
FR 3104. FOREST ECOLOGY.
FR 3107. FOREST ECOLOGY LABORATORY.
FR 3110. COLLOQUIUM IN NATURAL RESOURCES.
FR 3201. FIELD FOREST MEASUREMENTS.
FR 3225/5225. DIRECTED STUDY EXPERIENCE.
FR 5100. SILVICULTURE.
FR 5101. FIELD SILVICULTURE.
FR 5104. FOREST ECOLOGY.
FR 5106. SENIOR SILVICULTURE SEMINAR.
FR 5110. FORESTRY APPLICATIONS OF MICROCOMPUTERS.
FR 5114. FOREST HYDROLOGY.
FR 5115. FOREST HYDROLOGY, FIELD APPLICATIONS.
FR 5120. INTRODUCTORY TREE PHYSIOLOGY AND GENETICS.
FR 5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS.
FR 5152. FOREST GENETICS.
FR 5153. ADVANCED FOREST HYDROLOGY.
FR 5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS.
FR 5200. AERIAL PHOTO INTERPRETATION.
FR 5212. NATURAL RESOURCES INVENTORY.
FR 5215. FOREST FIRE MANAGEMENT.
FR 5220. REMOTE SENSING, FOREST RESOURCES INVENTORY.
FR 5226. FOREST ECONOMICS AND PLANNING.
FR 5236. FOREST RECREATION PLANNING.
FR 5240. NATURAL RESOURCE POLICY AND ADMINISTRATION.
FR 5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES.
FR 5248. HARVESTING AND ENGINEERING.
FR 5264. QUANTITATIVE TECHNIQUES IN FOREST MANAGEMENT.
FR 5401. SENIOR TOPICS.
FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION.
FR 5500. URBAN FOREST MANAGEMENT.
FR 5703. COLLOQUIUM IN NATURAL RESOURCES.
FR 8100. RESEARCH PROBLEMS: SILVICULTURE.
FR 8101. RESEARCH PROBLEMS: FOREST TREE PHYSIOLOGY.
FR 8102. RESEARCH PROBLEMS: FOREST TREE GENETICS.
FR 8103. RESEARCH PROBLEMS: FOREST HYDROLOGY.
FR 8104. RESEARCH PROBLEMS: FOREST ECOLOGY.
FR 8105. ADVANCED FIELD SILVICULTURE.
FR 8106. TOPICS IN SILVICULTURE—FOREST SOILS.
FR 8108. FOUNDATIONS OF RENEWABLE RESOURCES RESEARCH.
FR 8200. RESEARCH PROBLEMS: FOREST MANAGEMENT.
FR 8201. RESEARCH PROBLEMS: FOREST ECONOMICS.
FR 8202. RESEARCH PROBLEMS: FOREST MEASUREMENTS.
FR 8203. RESEARCH PROBLEMS: FOREST RECREATION.
FR 8204. RESEARCH PROBLEMS: FOREST POLICY.
FR 8205. RESEARCH PROBLEMS: REMOTE SENSING.
FR 8207. ECONOMIC ANALYSIS OF FORESTRY PROJECTS.
FR 8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES.

Plant Pathology

PlPa 5050. FOREST PATHOLOGY.

Soil Science

Soil 5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.

INTERNATIONAL ISSUES/ WORLD RESOURCES

Agricultural and Applied Economics

AgEc 5710. U.S. AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.

AgEc 5730. EUROPEAN AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.

Agricultural Engineering Technology

AgET 5027. APPROPRIATE TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT.

Agronomy and Plant Genetics

Agro 3010. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.

Agro 5110. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS.

Animal and Plant Systems

AnPl 3010. ENVIRONMENT AND WORLD FOOD PRODUCTION.

Anthropology

Anth 5117. ANTHROPOLOGY OF RESOURCE MANAGEMENT.

Business, Government, and Society

BGS 8019. TOPICS IN BUSINESS AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.

Ecology, Evolution, and Behavior

EEB 5016. ECOLOGICAL PLANT GEOGRAPHY.

EEB 5129. MAMMALOGY.

Fisheries and Wildlife

FW 5129. MAMMALOGY.

FW 5455. AQUACULTURE.

Forest Resources

FR 3250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES.

FR 5250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES.

FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION.

FR 8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES.

General College

GC 1112. ECOLOGICAL EVALUATION OF ENVIRONMENTAL PROBLEMS.

Geography

Geog 3421. CLIMATOLOGY.

Geog 3431. INTRODUCTION TO PLANT AND ANIMAL GEOGRAPHY.

Geology and Geophysics

Geo 5108. ADVANCED ENVIRONMENTAL GEOLOGY.

Geo 8262. QUATERNARY PALEOECOLOGY AND CLIMATE.

Interedepartmental Study

ID 5525-5526. GARBAGE, GOVERNMENT, AND THE GLOBE.

Natural Resources and Environmental Studies

NRES 3060/5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT.

Plant Biology

PBio 3201. INTRODUCTORY PLANT SYSTEMATICS.

Political Science

Pol 3872. INTERNATIONAL ORGANIZATIONS AND THE ENVIRONMENT.

Public Affairs

PA 5791. SCIENCE, TECHNOLOGY AND INTERNATIONAL AFFAIRS.

Sociology

Soc 3551. WORLD POPULATION PROBLEMS.

Soc 3960. ENVIRONMENTAL SOCIOLOGY.

Soil Science

Soil 3220. SOIL CONSERVATION AND LAND USE MANAGEMENT.
Soil 5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.

LAKE ITASCA FORESTRY AND BIOLOGICAL STATION

Biology

Biol 5841. ECOLOGY.

Ecology, Evolution, and Behavior

EEB 5814. PLANT COMMUNITY ECOLOGY.
EEB 5817. VERTEBRATE ECOLOGY.
EEB 5834. FIELD ORNITHOLOGY.

Entomology

Ent 5600. FIELD ENTOMOLOGY.
Ent 5610. AQUATIC ENTOMOLOGY.

Fisheries and Wildlife

FW 3600. FISHERIES AND WILDLIFE FIELD TECHNIQUES.

Forest Resources

FR 3100. IMPORTANT FOREST PLANTS.
FR 3101. NORTHERN FOREST ECOSYSTEMS.
FR 3106. IMPORTANT PLANTS: FISHERIES AND WILDLIFE HABITATS.
FR 3201. FIELD FOREST MEASUREMENTS.
FR 5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS.

Plant Biology

PBio 5801. PLAINS AND BOREAL FLORA.
PBio 5811. FRESHWATER ALGAE.

LAKES AND WETLANDS

Civil Engineering

CE 8430. LAKE AND RESERVOIR HYDRODYNAMICS.
CE 8551. SEMINAR: MODELS OF AQUATIC ENVIRONMENTS.

Ecology, Evolution, and Behavior

EEB 5601. LIMNOLOGY.
EEB 5607. ECOLOGY OF ANIMAL PLANKTON.
EEB 5621. LIMNOLOGY LABORATORY.

Geology and Geophysics

Geo 5601. LIMNOLOGY.
Geo 8602. ADVANCED LIMNOLOGY.

Plant Biology

PBio 5231. INTRODUCTION TO THE ALGAE.

LAND USE

Agricultural and Applied Economics

AgEc 5600. LAND ECONOMICS.
AgEc 8360. LAND ECONOMICS AND POLICY.

Forest Resources

FR 5262. REMOTE SENSING OF NATURAL RESOURCES.

Geography

Geog 3361. LAND USE AND THE FEDERAL GOVERNMENT.
Geog 3362. LAND USE AND STATE GOVERNMENT.
Geog 5361. LAND IN AMERICA.
Geog 8340. SEMINAR: LAND USE PLANNING.
Geog 8344. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.
Geog 8345. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA.

Landscape Architecture

LA 1031. INTRODUCTION TO LANDSCAPE ARCHITECTURE.
LA 5107. REGIONAL LANDSCAPE DESIGN.
LA 5119. PLANTING DESIGN: ECOLOGICAL PRINCIPLES/LAND USE CONCEPTS AND IMPLEMENTATION.

LA 5562. INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS.
LA 8390. DESIGNING THE LONG-TERM LANDSCAPE.

Public Affairs

PA 5601. LAND USE.
PA 5622. MANAGING URBAN GROWTH AND CHANGE.
PA 8691-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN LAND USE AND HUMAN SETTLEMENTS.

Rhetoric

Rhet 1310. HUMANITIES: THE LAND IN AMERICAN EXPERIENCE.

Soil Science

Soil 3220. SOIL CONSERVATION AND LAND USE MANAGEMENT.
Soil 5560. INTERPRETATION OF LAND RESOURCES.

LIFE SCIENCES

Biology

Biol 1008. INTRODUCTORY BIOLOGY: AN EVOLUTIONARY APPROACH.
Biol 1008H. INTRODUCTORY BIOLOGY: AN EVOLUTIONARY APPROACH.
Biol 5041. ECOLOGY.
Biol 5841. ECOLOGY.

Conservation Biology

CB 8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES.

Ecology, Evolution, and Behavior

EEB 3001. INTRODUCTION TO ECOLOGY.
EEB 3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS.
EEB 5051. ANALYSIS OF POPULATIONS.
EEB 5608. ECOSYSTEMS: FORM AND FUNCTION.

Entomology

Ent 5040. INSECT ECOLOGY.
Ent 5320. ECOLOGY OF AGRICULTURE.

Fisheries and Wildlife

FW 5129. MAMMALOGY.

Forest Resources

FR 5221. PLANT MOLECULAR EVOLUTION.

Genetics and Cell Biology

GCB 3002. HUMAN GENETICS, SOCIAL AFFAIRS.

Microbiology

MicB 3103. GENERAL MICROBIOLOGY.
MicB 5352. APPLIED MICROBIOLOGY.
MicB 5611. MICROBIAL ECOLOGY.

Plant Pathology

PBio 5183. WATER, MINERALS, AND TRANSLOCATION.

Soil Science

Soil 5605. MICROBIAL ECOLOGY.

NATURALIST STUDIES

Biology

Biol 5841. ECOLOGY.

Conservation Biology

CB 8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES.

Ecology, Evolution, and Behavior

EEB 5008. QUATERNARY ECOLOGY.
EEB 5014. ECOLOGY OF PLANT COMMUNITIES.
EEB 5016. ECOLOGICAL PLANT GEOGRAPHY.
EEB 5122. PLANT/ANIMAL INTERACTIONS.
EEB 5129. MAMMALOGY.
EEB 5134. INTRODUCTION TO ORNITHOLOGY.
EEB 5814. PLANT COMMUNITY ECOLOGY.

Entomology

Ent 3005. INTRODUCTORY ENTOMOLOGY.
Ent 5600. FIELD ENTOMOLOGY.

Forest Resources

FR 3100. IMPORTANT FOREST PLANTS.
FR 3106. IMPORTANT PLANTS: FISHERIES AND WILDLIFE HABITATS.
FR 5152. FOREST GENETICS.
FR 5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS.
FR 5221. PLANT MOLECULAR EVOLUTION.
FR 5703. COLLOQUIUM IN NATURAL RESOURCES.

General College

GC 1133. NATURE STUDY.

Geography

Geog 3431. INTRODUCTION TO PLANT AND ANIMAL GEOGRAPHY.
Geog 5441. QUATERNARY LANDSCAPE EVOLUTION.

Plant Biology

PBio 1009. MINNESOTA PLANT LIFE.
PBio 1012. PLANTS USEFUL TO HUMANS.
PBio 3201. INTRODUCTORY PLANT SYSTEMATICS.
PBio 5103. ALGAE, FUNGI, AND BRYOPHYTES.
PBio 5183. WATER, MINERALS, AND TRANSLOCATION.
PBio 5801. PLAINS AND BOREAL FLORA.
PBio 5811. FRESHWATER ALGAE.

Plant Pathology

PlPa 5002. INTRODUCTORY PLANT PATHOLOGY.
PlPa 8003. PLANT DISEASE THEORY III, POPULATIONS.

Soil Science

Soil 5610. SOIL BIOLOGY.

PEST AND DISEASE CONTROL

Agronomy and Plant Genetics

Agro 5030. WEED CONTROL.
Agro 8030. MODE OF ACTION OF HERBICIDES.
Agro 8040. WEED BIOLOGY.
Agro 8070. COLLOQUIUM IN AGROECOLOGY.

Entomology

Ent 1005. ECONOMIC ENTOMOLOGY.
Ent 5210. INSECT PEST MANAGEMENT.
Ent 5250. FOREST ENTOMOLOGY.
Ent 5280. LIVESTOCK ENTOMOLOGY.
Ent 5610. AQUATIC ENTOMOLOGY.
Ent 8240. COLLOQUIUM IN INSECT ECOLOGY.

Plant Pathology

PlPa 5002. INTRODUCTORY PLANT PATHOLOGY.
PlPa 5050. FOREST PATHOLOGY.
PlPa 5102. ECOLOGY OF FUNGI.
PlPa 5105. INTRODUCTION TO THE STUDY OF FUNGI.
PlPa 5106. MYCOLOGY: ASCOMYCETES—FUNGI IMPERFECTI.
PlPa 5107. MYCOLOGY: BASIDIOMYCETES.
PlPa 8003. PLANT DISEASE THEORY III, POPULATIONS.
PlPa 8111. FUNGAL GENETICS.

PUBLIC POLICY

Agricultural and Applied Economics

AgEc 5650. ECONOMICS FOR NATURAL RESOURCE POLICY.
AgEc 5710. U.S. AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.
AgEc 5730. EUROPEAN AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY.

Agricultural Engineering Technology

AgET 5027. APPROPRIATE TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT.

Agronomy and Plant Genetics

Agro 5001, Section 2. SUSTAINABILITY, ECOLOGY, AND AGRICULTURE: AN INTERDISCIPLINARY INQUIRY.

Biology

Biol 3051. BIOLOGY AND THE FUTURE OF THE EARTH.
Biol 5951. SOCIAL USES OF BIOLOGY.

Business, Government, and Society

BGS 3003. BUSINESS AND THE NATURAL ENVIRONMENT.

BGS 3019/H3019 TOPICS IN BUSINESS, GOVERNMENT AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.

BGS 8019. TOPICS IN BUSINESS AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.

BGS 8055. BUSINESS, GOVERNMENT AND MACROECONOMICS.

BGS 8202. EXTERNAL AFFAIRS MANAGEMENT.

Environmental and Occupational Health

PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: PRINCIPLES OF ENVIRONMENTAL HEALTH LAW.

PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: POLLUTION CONTROL LAW.

Forest Resources

FR 5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES.

Honors Colloquia

HCol 1010. HONORS COLLOQUIUM. FROM VCRs TO PCBs: COMMUNICATING ABOUT SCIENCE.

Interdepartmental Study

ID 3970. DIRECTED STUDIES.

ID 5525-5526. GARBAGE, GOVERNMENT, AND THE GLOBE.

Journalism and Mass Communication

Jour 5133. INTERPRETIVE REPORTING ABOUT SCIENCE.

Law School

Law 5215. ENVIRONMENTAL LAW.

Law 5885. ADVANCED ENVIRONMENTAL LAW.

Natural Resources and Environmental Studies

NRES 1010. ISSUES IN THE ENVIRONMENT.

NRES 1040. NATURAL RESOURCES AS RAW MATERIALS.

Plant Pathology

PlPa 5007. AIR POLLUTION AND THEIR EFFECTS ON PLANTS.

Political Science

Pol 3872. INTERNATIONAL ORGANIZATIONS AND THE ENVIRONMENT.

Pol 5523. THE POLITICS OF THE REGULATORY PROCESS.

Public Affairs

PA 5701. TECHNOLOGY PLANNING I.

PA 5721. ENVIRONMENTAL POLICY I.

PA 5722. ENVIRONMENTAL POLICY II.

PA 5791. SCIENCE, TECHNOLOGY AND INTERNATIONAL AFFAIRS.

PA 5792. TOPICS IN ENVIRONMENT AND ENERGY POLICY.

PA 5794. ECONOMICS OF NATURAL RESOURCE POLICY.

PA 8791-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY.

Soil Science

Soil 1020. THE SOIL RESOURCE.

RECREATION AND OUTDOOR EDUCATION

Elementary Education

Elem 5348. WORKSHOP: OUTDOOR SCIENCE EDUCATION.

Forest Resources

FR 5231. RANGE MANAGEMENT.

FR 5232. MANAGEMENT OF RECREATIONAL LANDS.

FR 5233. PRINCIPLES OF OUTDOOR RECREATION PLANNING.

FR 5236. FOREST RECREATION PLANNING.

FR 5257. RECREATION LAND POLICY.

FR 5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR.

FR 5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION.

FR 8206. ADVANCED MANAGEMENT OF RECREATIONAL LANDS.

Landscape Architecture

LA 5105. RECREATIONAL PLANNING AND DESIGN.

Recreation, Park, and Leisure Studies

Rec 5250. FINANCING LEISURE SERVICES.
Rec 5300. FOUNDATIONS OF OUTDOOR EDUCATION.
Rec 5310. PROGRAMMING IN OUTDOOR EDUCATION.
Rec 5350. WILDERNESS OUTDOOR RECREATION PROGRAMMING.

RESOURCE MANAGEMENT

Agricultural and Applied Economics

AgEc 3610. RESOURCE DEVELOPMENT AND ENVIRONMENTAL ECONOMICS.
AgEc 5650. ECONOMICS OF NATURAL RESOURCE POLICY.
AgEc 8264. RESOURCE ECONOMICS.
AgEc 8364. SEMINAR: RESOURCE AND ENVIRONMENTAL ECONOMICS.

Anthropology

Anth 5117. ANTHROPOLOGY OF RESOURCE MANAGEMENT.

Business, Government, and Society

BGS 3019/H3019. TOPICS IN BUSINESS, GOVERNMENT AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.
BGS 8019. TOPICS IN BUSINESS AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT.

Economics

Econ 5611. RESOURCE AND ENVIRONMENTAL ECONOMICS.

Fisheries and Wildlife

FW 1101. ETHICS AND VALUES IN RESOURCE MANAGEMENT.
FW 5455. AQUACULTURE.
FW 5620. GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR FISHERIES, WILDLIFE, AND BIOLOGICAL CONSERVATION.

Forest Resources

FR 1201. CONSERVATION OF NATURAL RESOURCES.
FR 1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES.
FR 3103. METEOROLOGY AND CLIMATOLOGY FOR RESOURCE MANAGERS.
FR 3110. COLLOQUIUM IN NATURAL RESOURCES.
FR 3250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES.
FR 3300. ELEMENTS OF SURVEYING.
FR 5130. GEOGRAPHIC INFORMATION SYSTEMS IN NATURAL RESOURCE ANALYSIS.
FR 5200. AERIAL PHOTO INTERPRETATION.
FR 5212. NATURAL RESOURCES INVENTORY.
FR 5220. REMOTE SENSING, FOREST RESOURCES INVENTORY.
FR 5231. RANGE MANAGEMENT.
FR 5240. NATURAL RESOURCE POLICY AND ADMINISTRATION.
FR 5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES.
FR 5250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES.
FR 5262. REMOTE SENSING OF NATURAL RESOURCES.
FR 5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION.
FR 5412. ADVANCED REMOTE SENSING.
FR 5703. COLLOQUIUM IN NATURAL RESOURCES.
FR 8205. RESEARCH PROBLEMS: REMOTE SENSING.
FR 8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES.

Housing

Hsg 1401 RESIDENTIAL TECHNOLOGY.
Hsg 5482. THE FAMILY AND ENERGY ISSUES.

Landscape Architecture

LA 8390. DESIGNING THE LONG-TERM LANDSCAPE.

Natural Resources and Environmental Studies

NRES 1001. ORIENTATION TO NATURAL RESOURCES AND ENVIRONMENTAL STUDIES.
NRES 1040. NATURAL RESOURCES AS RAW MATERIALS.
NRES 3001. COLLOQUIUM IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES.
NRES 3050. EXPERIENCE AND TRAINING IN A FIELD SETTING.
NRES 3060/5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT.

NRES 3225. NRES DIRECTED STUDY EXPERIENCE.
NRES 5100. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES.
NRES 5210. SURVEY, MEASUREMENT, AND MODELLING METHODS FOR NATURAL RESOURCES I.
NRES 5220. SURVEY MEASUREMENT AND MODELLING METHODS FOR NATURAL RESOURCES II.
NRES 5225. NRES DIRECTED STUDY EXPERIENCE.

Public Affairs

PA 5794. ECONOMICS OF NATURAL RESOURCE POLICY.

SOIL RESOURCES

Agricultural Engineering

AgEn 3052. ENGINEERING PRINCIPLES OF SOIL-WATER-PLANT SYSTEMS.
AgEn 5540. WATERSHED ENGINEERING.
AgEn 5550. WATER MANAGEMENT ENGINEERING.
AgEn 8700. MOISTURE AND HEAT TRANSFER.

Agricultural Engineering Technology

AgET 5400. DRAINAGE AND IRRIGATION.

Environmental and Occupational Health

PubH 5186. ENVIRONMENTAL CHEMISTRY.

Forest Resources

FR 5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS.
FR 8105. ADVANCED FIELD SILVICULTURE.
FR 8106. TOPICS IN SILVICULTURE—FOREST SOILS.

Soil Science

Soil 1020. THE SOIL RESOURCE.
Soil 3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY.
Soil 3125. BASIC SOIL SCIENCE.
Soil 3220. SOIL CONSERVATION AND LAND USE MANAGEMENT.
Soil 5210. SOIL PHYSICAL PROPERTIES AND THE ENVIRONMENT.
Soil 5510. FIELD STUDY OF SOILS FOR ENVIRONMENTAL ASSESSMENT.
Soil 5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION.
Soil 5560. INTERPRETATION OF LAND RESOURCES.
Soil 5610. SOIL BIOLOGY.

WASTE MANAGEMENT

Agricultural Engineering

AgEn 5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING.

Architecture

Arch 3064-3065. ENVIRONMENTAL MANAGEMENT AND CONTROL.

Biology

Biol 3051. BIOLOGY AND THE FUTURE OF THE EARTH.

Civil Engineering

CE 5097. SOLID AND HAZARDOUS WASTE PROCESSING I.
CE 5098. SOLID AND HAZARDOUS WASTE PROCESSING II.
CE 5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS.
CE 5510. SOLID AND HAZARDOUS WASTE MANAGEMENT.
CE 5515. WATER AND WASTEWATER MICROBIOLOGY.
CE 8500. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT.
CE 8501. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT—PART II.
CE 8502. BIOLOGICAL AND CHEMICAL PROCESSES FOR WASTEWATER TREATMENT.

Environmental and Occupational Health

PubH 5233. BIOLOGICAL SAFETY.
PubH 5253. INTRODUCTION: HAZARDOUS WASTE MANAGEMENT.
PubH 5254. HAZARDOUS WASTE MANAGEMENT.

Interdepartmental Study

ID 5525-5526. GARBAGE, GOVERNMENT, AND THE GLOBE.

Law School

Law 5885. ADVANCED ENVIRONMENTAL LAW.

Natural Resources and Environmental Studies

NRES 1010. ISSUES IN THE ENVIRONMENT.
NRES 5600. PRINCIPLES OF WASTE MANAGEMENT.

Public Affairs

PA 8791-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY.

Soil Science

Soil 5560. INTERPRETATION OF LAND RESOURCES.

WATER RESOURCES

Agricultural Engineering

AgEn 3052. ENGINEERING PRINCIPLES OF SOIL-WATER-PLANT SYSTEMS.
AgEn 5540. WATERSHED ENGINEERING.
AgEn 5550. WATER MANAGEMENT ENGINEERING.
AgEn 8500. HYDROLOGIC MODELING—SMALL WATERSHEDS.

Agricultural Engineering Technology

AgET 5410. HYDROLOGY AND WATER QUALITY.

Civil Engineering

CE 5401. WATER RESOURCES ENGINEERING.
CE 5405. HYDROLOGY AND HYDROLOGIC DESIGN.
CE 5425. GROUNDWATER MECHANICS.
CE 5426. COMPUTER MODELING OF GROUNDWATER FLOW.
CE 5500. ANALYSIS AND DESIGN OF WATER SUPPLY SYSTEMS.
CE 5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS.
CE 5505. WATER QUALITY ENGINEERING.
CE 5506. ENVIRONMENTAL WATER CHEMISTRY.
CE 5540. ANALYSIS OF GROUNDWATER-SOIL POLLUTION ABATEMENT TECHNOLOGY.
CE 8406. SEMINAR: ADVANCED HYDROLOGY.
CE 8419. WATER RESOURCES SYSTEMS SIMULATION.
CE 8425. ADVANCED GROUNDWATER MECHANICS.
CE 8500. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT.
CE 8501. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT—PART II.
CE 8502. BIOLOGICAL AND CHEMICAL PROCESSES FOR WASTEWATER TREATMENT.
CE 8505. AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS.
CE 8506. AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS.
CE 8550. ANALYSIS AND MODELING OF AQUATIC ENVIRONMENTS.
CE 8551. SEMINAR: MODELS OF AQUATIC ENVIRONMENTS.

Ecology, Evolution, and Behavior

EEB 5608. ECOSYSTEMS: FORM AND FUNCTION.

Environmental and Occupational Health

PubH 5186. ENVIRONMENTAL CHEMISTRY.
PubH 5242. ENVIRONMENTAL HEALTH ASPECTS OF GROUNDWATER SYSTEMS.
PubH 5243. WATER AND HEALTH.

Fisheries and Wildlife

FW 5460. POLLUTION IMPACTS ON AQUATIC SYSTEMS.

Forest Resources

FR 5114. FOREST HYDROLOGY.
FR 5115. FOREST HYDROLOGY, FIELD APPLICATIONS.
FR 5153. ADVANCED FOREST HYDROLOGY.
FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION.

Geography

Geog 5444. GEOGRAPHY OF WATER RESOURCES.

Geology and Geophysics

Geo 5313. AQUEOUS GEOCHEMISTRY.
Geo 5611. GROUNDWATER GEOLOGY.
Geo 8612. ANALYTICAL GEOHYDROLOGY.

Natural Resources and Environmental Studies

NRES 3060/5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT.

Soil Science

Soil 3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY.
Soil 5210. SOIL PHYSICAL PROPERTIES AND THE ENVIRONMENT.

III. COURSES LISTED BY DEPARTMENT

AEROSPACE ENGINEERING AND MECHANICS (AEM)

Institute of Technology

107 Akerman, 625-8000
Theodore Wilson, 107 Akerman, 625-0856

AEM 5687. INTRODUCTION TO ACOUSTICS AND ENVIRONMENTAL NOISE. (4 cr; prereq Phys 1291 or Phys 1341 or equiv, Math 3321 or equiv; IT or grad IT stu; 3 lect and 1 lab hrs per wk; not offered 1992-93)) Day class

Derivation of the wave equation, plane wave solution, transmission and reflection at boundaries, resonators and mufflers, three-dimensional wave propogation, properties of environmental noise sources, hearing and perception of sound, acoustical properties of rooms, laboratory experience in sound and noise measurements and noise control techniques.

AGRICULTURAL AND APPLIED ECONOMICS (AgEc)

College of Agriculture

231 Classroom Office Building, 625-1222
Mark Bultmann, 231 Classroom Office Building, 625-9710

AgEc 3610. RESOURCE DEVELOPMENT AND ENVIRONMENTAL ECONOMICS. (3 cr; prereq 1101, 1102 or Econ 1101, 1102 or #) Day class

Basic concepts of resource use including physical and economic classifications; physical and economic feasibility; benefits and costs; external effects; cost sharing; selected resource use problems. Economic areas and units for planning and development; generation of alternative program elements and development of consequences; problems in choosing elements for an optimum resource development program.

AgEc 5600. LAND ECONOMICS. (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102, or Econ 3101, 3102 or #) Day class

Land as a factor of production; land use, classification, and value; sales and rental markets for land; domestic and foreign land policies.

AgEc 5650. ECONOMICS OF NATURAL RESOURCE POLICY. (4 cr for undergrad, 3 cr for grad; prereq 3101 or econ 3101 or AgEc 3610 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

(Same as PA 5794) Application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.

AgEc 5710. U.S. AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY. (3 cr; prereq 3003, 3006, 3007 or #) Day class

✿ **new** Development of U.S. agriculture and U.S. agricultural and trade policy; agricultural input and commodity markets; effects of U.S. environmental policies on agriculture; design and economics effects of U.S. ag ricultural policy; determinants of U.S. agricultural and trade policies.

AgEc 5730. EUROPEAN AGRICULTURE: FARM, FOOD AND ENVIRONMENTAL POLICY. (4 cr; prereq 3003 or Econ 3101 or #) Day class

✿ **new** Characteristics of agriculture in Europe; determinants of development of European agriculture; goals and instruments of EC agricultural policy.

AgEc 8264. RESOURCE ECONOMICS. (3 cr; prereq Econ 5162 or ¶Econ 5162 or #) Day class

Economic analysis relevant to resource use and management; concepts of joint production and joint costs; external effects of resource decisions; applications of public finance, welfare economics, capital theory, and discount rates; cost-benefit analysis and other decision-making approaches; investment and management problems related to water resources, outdoor recreation, forestry, and fisheries; economic problems of air pollution and environmental quality.

AgEc 8360. LAND ECONOMICS AND POLICY. (3 cr; offered when demand warrants) Day class

AgEc 8364. SEMINAR: RESOURCE AND ENVIRONMENTAL ECONOMICS. (3 cr; offered when demand warrants) Day class

AGRICULTURAL ENGINEERING (AgEn)

Institute of Technology

213 Agricultural Engineering, 625-7733
J. L. Nieber, 203 Agricultural Engineering, 625-6724
C. J. Clanton, 230 Agricultural Engineering, 625-9218

AgEn 3052. ENGINEERING PRINCIPLES OF SOIL-WATER-PLANT SYSTEMS. (4 cr; prereq IT student, biology, AEM 3016 or ¶AEM 3016; 3 lect and 3 lab hrs per wk) Day class

Mechanical and hydraulic properties of soil; moisture relations; strength parameters for structural and mechanical design. Soil-machine action in tillage and traction. Energy and water balance in the soil-water-plant system. Plant structure and growth. Engineering and management requirements.

AgEn 5540. WATERSHED ENGINEERING. (4 cr; prereq IT upper division or grad IT major, 3052 or CE 3300, CE 3400; 3 lect and 3 lab hrs per wk) Day class

Application of engineering principles to the management of surface runoff and soil water in agricultural, range and urban lands. Design of facilities for control of surface runoff to mitigate problems of flooding and degradation of surface water quality.

AgEn 5550. WATER MANAGEMENT ENGINEERING. (4 cr; prereq IT upper division or grad IT major, 3052 or CE 3300, CE 3400; 3 lect and 3 lab hrs per wk) Day class

Application of engineering principles to the management of water for production and environmental protection in agricultural systems. Design of facilities to irrigate and drain croplands and to enhance water quality.

AgEn 5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING. (4 cr; prereq 3052, Chem 1005, CE 3400, upper div IT or grad IT major; 3 lect and 3 lab hrs per wk) Day class

Sources and characteristics of agricultural wastes including livestock, food processing, and domestic wastes. Physical, biological, chemical, rheological, and microbiological properties. Effects on the environment. Collection, storage, treatment (aerobic and anaerobic), and utilization/disposal. Land application of livestock and food processing wastes, municipal effluents, and sludges. On-site sewage treatment.

AgEn 8500. HYDROLOGIC MODELING—SMALL WATERSHEDS. (4 cr; prereq CE 5405, grad IT major; 3 lect and 1 rec hrs per wk; offered alt yrs) Day class

Study and representation of hydrologic processes by mathematical models; infiltration, overland flow, return flow, evapotranspiration, channel flow, and storage. Time-flow relationships. Linear and nonlinear methods. Frequency relationships. Emphasis on parametric methods.

AgEn 8700. MOISTURE AND HEAT TRANSFER. (3 cr; prereq knowledge of differential equations and #, grad IT major; offered alt yrs) Day class

Mathematical study of transfer of moisture and heat in agricultural crops and soils.

AGRICULTURAL ENGINEERING TECHNOLOGY (AgET)

College of Agriculture

213 Agricultural Engineering, 625-7733
J. L. Nieber, 203 Agricultural Engineering, 625-6724
C. J. Clanton, 230 Agricultural Engineering, 625-9218

AgET 5027. APPROPRIATE TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT. (4 cr; prereq Math 1111, Chem 1001 or 1004, Phys 1041; 3 lect and 3 lab hrs per wk) Joint Day/Extension class

✿ **new** Definition, history, successes and failures of appropriate technology. Social and technical appropriateness. Water supply, treatment, storage, conveyance. Water pumps, sanitation. Power: pedal, wind, water, solar, rice-hull furnace, methane, Stirling-cycle engine. Building materials. Agricultural machinery and animal power. Transfer and adoption of technology. Lecture and laboratory.

AgET 5400. DRAINAGE AND IRRIGATION. (4 cr; prereq Soil 3210; 3 lect and 2 lab hrs per wk) Day class

Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.

AgET 5410. HYDROLOGY AND WATER QUALITY. (5 cr; prereq Math 1111, Phy 1041, Chem 1004, 1005; 3 lect, 3 lab, and 1 rec hrs per wk) Day class

The hydrologic cycle—precipitation, infiltration, evaporation, surface and subsurface runoff, and groundwater recharge. Flow in streams, flow in aquifers, flow measurement. Soil erosion, sediment transport and deposition. Chemical pollution of surface water and ground water.

AGRONOMY AND PLANT GENETICS (Agro)

College of Agriculture

411 Borlaug Hall, 625-7773
D. L. Wyse, 411 Borlaug Hall, 625-7064

Agro 3010. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS. (4 cr; prereq Biol 1009) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** (Same as Agro 5110) Principles of crop adaptation, distribution, and ecology in a context of current and projected world crop needs. Emphasis on the importance of adaptation to crop distribution and production and on the relationships of crops to the environmental factors of light, moisture, and temperature. Crop production practices as a means of managing environmental factors. Lecture and discussion.

Agro 5001, Section 2. SUSTAINABILITY, ECOLOGY, AND AGRICULTURE: AN INTERDISCIPLINARY INQUIRY. (3 cr; prereq jr, sr, grad or #) Note: This course is a special topic and will be offered only once, Fall 1992. Day class

✿ **new** Analysis of various ways sustainable agriculture can be defined and implemented; efficiency of conventional and sustainable production systems; current and potential public policies affecting agricultural production and research are analyzed.

Agro 5030. WEED CONTROL. (5 cr; prereq 1010 or #; 3020 or PBio 3131 recommended) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Survey of the magnitude of the weed problem. Regulatory aspects of weed control and herbicide usage. Principles and methods of weed control. Lecture and discussion.

Agro 5070. ECOLOGY OF FIELD CROPS. (3 cr; prereq 3010, 3020, 3030 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Concepts and approaches to crop community interactions, field conditions, density relationships, plant competition, growth analysis, allelpathy, multiple cropping, weed crop interactions, crop rotations, crop diversity, canopy architecture, and whole-system productivity. Lecture and discussion.

Agro 5110. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS. (3 cr; §3010; prereq Biol 1009) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** (Same as Agro 3110) Principles of crop adaptation, distribution, and ecology in a context of current and projected world crop needs. Emphasis on the importance of adaptation to crop distribution and production and on the relationships of crops to the environmental factors of light, moisture, and temperature. Crop production practices as a means of managing environmental factors. Lecture and discussion.

Agro 8030. MODE OF ACTION OF HERBICIDES. (3 cr; prereq 5030, PBio 5182, Biol 5001 or #; offered alt yrs) Day class

✿ **new** Classification and structure of herbicides, physiological processes affecting and affected by herbicides, review of selected literature on mode of action of herbicides.

Agro 8040. WEED BIOLOGY. (2 cr; prereq 5030, PBio 5131 or #; offered alt yrs) Day class

✿ **new** Critical review of literature on geographical distribution, habitat, growth and development, reproduction, population dynamics, economic importance of selected weeds.

Agro 8070. COLLOQUIUM IN AGROECOLOGY. (3 cr; prereq 5070, 8050 or #) Day class

✿ **new** Critical literature review. Topics may include competition, allelopathy, weed-crop interaction, intercropping, tillage systems, insect-plant or pathogen-plant interactions, systems analysis, modeling.

ANIMAL AND PLANT SYSTEMS (AnPl)

College of Agriculture

411 Borlaug Hall, 625-7773
Lawrence H. Smith, 411 Borlaug Hall, 625-2778

AnPl 3010. ENVIRONMENT AND WORLD FOOD PRODUCTION. (4 cr; prereq Biol 1008 or 1009) Day class

✿ **new** Sustainable food production via agriculture is crucial for humankind's survival. Agricultural systems are influenced by and impact the environment. This course examines ecological properties of world agricultural systems including issues of biodiversity, soil conservation, agricultural pollution, water quality, and waste management.

AnPl 5060. INTEGRATED MANAGEMENT OF CROPPING SYSTEMS. (4 cr) Day class

✿ **new** Case study/simulation and discussions considering integrated production management of selected agronomic and horticultural cropping systems in Minnesota. Emphasis on problem analysis, principle application, and decision making involving the integration of disciplines.

ANTHROPOLOGY (Anth)

College of Liberal Arts

215 Ford Hall, 625-3400
Eugene Ogan, 219 Ford Hall, 625-3424

Anth 5116. ECOLOGICAL ANTHROPOLOGY. (4 cr; prereq 1102, 3201 or 5102) Day class

Anthropological approaches to human-environment interactions. Discussion of Marxist, ecological, biological, humanistic, and ethnoscientific approaches to culture and resources. Key interactions in a wide range of settings, adaptations, and environments. Issues of energetics, production, consumption, values, and conservation.

Anth 5117. ANTHROPOLOGY OF RESOURCE MANAGEMENT. (4 cr) Joint Day/Extension class

Employmwent of a cultural ecological and systems approach to examine ways in which social institutions and cultural concepts are applied across world societies to develop, use, and manage key environmental resources. Comparative studies from contemporary and historical United States, western Europe, Africa, Asia, and the Caribbean.

ARCHITECTURE

College of Architecture and Landscape Architecture

110 Architecture, 624-7866
Julia Robinson, 110 Architecture, 624-7866

Arch 3060. TECHNOS: FORCE, FORM AND ARCHITECTURE. (4 cr; prereq Arch 1021, Arch major, and ¶Arch 3081) Day class

Introduction to fundamental conceptual frameworks that relate science, technology, and building expression to architectural form. Present day to ancient periods. The impact of climate, gravity, and sunlight are examined in four case study houses.

Arch 3064-3065. ENVIRONMENTAL MANAGEMENT AND CONTROL. (4 cr per qtr; prereq Arch major or adult special, 3062, 3083 or #; 4 lect hrs per wk) Day class

Environmental-mechanical considerations including comfort technology, space habitability, climate, psychometrics, control and management systems; waste management including plumbing systems and waste disposal techniques. Electrical systems, energy, power distribution and machinery; lighting systems, physiology of seeing, light sources and control; spatial acoustics, noise barriers, absorption.

BIOCHEMISTRY (BioC)

College of Biological Sciences

140 Gortner Lab, 624-7755
Kathleen Peterson, 223 Snyder Hall, 624-9717

BioC 5301. ECOLOGICAL BIOCHEMISTRY. (3 cr; A-F or S-N; prereq Biol 5001 or grade B or better in BioC 3031 or #) Day class

✿ **new** The biochemistry of environmental processes will be covered. Topics include biochemistry of organismal interactions, biological responses to environmental stress, gene transfer in the environment, and effects and fate of environmental toxins.

BIOLOGY (Biol)

College of Biological Sciences

123 Snyder Hall, 624-2244
Kathleen Peterson, 223 Snyder Hall, 624-9717

Biol 1008. INTRODUCTORY BIOLOGY: AN EVOLUTIONARY APPROACH. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Description of evolution as the unifying principle in biology; organization and change in the biological world and the origin of humans.

Biol 1008H. INTRODUCTORY BIOLOGY: AN EVOLUTIONARY APPROACH. (4 cr) Joint Day/ExtENSION class: refer to daytime *Class Schedule*

For description, see 1008. Intended especially for honors students or their equivalent who plan to major in a life science discipline.

Biol 3051. BIOLOGY AND THE FUTURE OF THE EARTH. (4 cr; A-F or S-N; bioscience students may not apply these credits to the major) JointDay/Extension class limited to 25 Extension students

Nontechnical discussion of current environmental issues including air and water pollution, human population growth, toxic and hazardous wastes, urbanization, resource economics, biological diversity, energy, health, and environmental ethics.

Biol 5041. ECOLOGY. (4 cr; 5841, prereq Math 1142 or 1211, Biol 1103 or 1106 or 3011 or 3012) Joint Day/Extension class: refer to daytime *Class Schedule*

Growth, structure, and evolution of populations. Pairwise biotic interactions between species, effect on diversity and structure of natural communities. Nutrient dynamics, function, productivity, and temporal stability of ecosystems.

Biol 5841. ECOLOGY. (5 cr; 5041; prereq 1103 or 1106 or 3011 or 3012, Math 1142 or 1221, Δ) Day class

Growth, structure, and evolution of populations. Pairwise biotic interactions between species and their effect on the diversity and structure of natural communities. Nutrient dynamics, function, productivity, and temporal stability of ecosystems. Field work at the Itasca station.

Biol 5951. SOCIAL USES OF BIOLOGY. (4 cr; S-N only; prereq 10 cr sciences) Joint Day/Extension class: refer to daytime *Class Schedule*

Influence of biological science on the quality of human life: agriculture, medicine, occupational health, environmental science, and theories of human nature. Responsibilities and roles of biologists in policy formulation in the scientific and political world.

BUSINESS, GOVERNMENT, AND SOCIETY (BGS)

Strategic Management and Organization

School of Management

835 Management and Economics, 624-5232
A. Marcus, 871 Management and Economics, 624-2812

BGS 3002. BUSINESS AND SOCIETY. (4 cr; prereq at least 90 cr completed or in progress; may not be taken S-N) Extension class

Examines the strategic and dynamic relations of business and society in a goal-oriented and problem-solving context. Focuses on the interfaces of business institutions with the physical environment, the social milieu, the political process and economic activity. Gives specific attention to the ongoing debate regarding national priorities and the respective roles of the private and public sectors concerning the challenges confronting U.S. society. Includes assessment of the concept, determinants, and indicators of the "quality of life" and the social responsibilities of business.

BGS 3003. BUSINESS AND THE NATURAL ENVIRONMENT. (4 cr; prereq jr or sr and at least 90 credits completed or in progress; may not be taken S-N) Extension class

Business and its relationship to the natural environment. The use by industry of renewable and nonrenewable resources. Management and disposal of toxic wastes, including methods for waste reduction. Environmental deterioration caused by businesses to air, land, and water. Business solutions to environmental problems. In-class debates on current environmental/energy issues.

BGS 3019/H3019. TOPICS IN BUSINESS, GOVERNMENT AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT. Offered at night through daytime *Class Schedule.*

✿ **new** The impacts of business on the natural environment are very great. These impacts are both national and international in nature. Subsequent social, legal, and economic reactions to these environmental impacts may have consequences not only for an individual firm's profitability and survival, but also for global competitiveness and economic development. Solutions to environmental problems range from moral appeals and voluntary assumption of corporate responsibility to government regulation and government-imposed incentive strategies. This course will examine the reciprocal impacts of the firm and environmental/natural resource issues and will investigate various possible solutions to business-related environmental problems. It will focus on how companies cope with these issues, assessing both the role of internal corporate functions and of corporate external relations and stakeholder management.

BGS 8019. TOPICS IN BUSINESS AND SOCIETY: BUSINESS AND THE PHYSICAL ENVIRONMENT. (3 cr) Offered at night through daytime *Class Schedule*

The impacts of business on the natural environment are very great. These impacts are both national and international in nature. Subsequent social, legal, and economic reactions to these environmental impacts may have consequences not only for an individual firm's profitability and survival, but also for global competitiveness and economic development. Solutions to environmental

problems range from moral appeals and voluntary assumption of corporate responsibility to government regulation and government-imposed incentive strategies. This course will examine the reciprocal impacts of the firm and environmental/natural resource issues and will investigate various possible solutions to business-related environmental problems. It will focus on how companies cope with these issues, assessing both the role of internal corporate functions and of corporate external relations and stakeholder management.

BGS 8055. BUSINESS, GOVERNMENT AND MACRO-ECONOMICS. (4 cr) Day class

Roles of government and business in society; alternative systems of economic and political values; social, political, economic, and cultural conflicts affecting the business sector.

BGS 8202. EXTERNAL AFFAIRS MANAGEMENT. (4 cr; prereq MBA 8055, grad mgmt/IR student or # and grad school mgmt approval) Day class

Managing key aspects and issues that face business managers including environmental protection and natural resource issues. Discussion of development of legal framework for environmental control.

CIVIL ENGINEERING (CE)

Institute of Technology

122 Civil and Mineral Engineering, 625-5522
M. Semmens, 150 Civil and Mineral Engineering, 625-9857
W. Maier, 148 Civil and Mineral Engineering, 625-3016

CE 5003. EARTH-SHELTERED BUILDING DESIGN. (2 cr) Day class

✿ **new** Use and design of underground/earth-sheltered facilities for residential and non-residential purposes. Energy use, planning, security, environment, building design, landscaping, building codes, financing, and psychological considerations.

CE 5004. UNDERGROUND CONSTRUCTION ENGINEERING. (4 cr; pre req IT upper division, 5003) Day class

✿ **new** Application of structural and geotechnical techniques to earth-sheltered buildings; construction techniques and problems. Topics include retaining systems, structural loads, drainage systems, waterproofing, site investigation, contracting practices, instrumentation, and heat transfer calculations. Housing, large scale buildings, and mines space.

CE 5097. SOLID AND HAZARDOUS WASTE PROCESSING I. (4 cr; prereq IT upper division, grad student, or #) Day class

✿ **new** Physical and chemical principles and their application to unit operations and processes for recovery and recycling of solid and hazardous wastes. Remediation techniques on solid and hazardous wastes originating from manufacturing industries, municipal waste treatment plants, electric power utilities, and the mining industry.

CE 5098. SOLID AND HAZARDOUS WASTE PROCESSING II. (4 cr; prereq CE 5097 or #) Day class

✿ **new** Continuation of CE 5097 with emphasis on pyro-processing and high temperature treatment approaches; chemistry of high temperature systems; thermal incineration principles; novel approaches for elimination of ash in incinerators and utility coal burners via slagging combustion and vitrification; developing technologies in high temperature treatment of hazardous wastes.

CE 5212. TRANSPORTATION PRODUCTIVITY AND ENERGY CONSERVATION. (4 cr; prereq #; offered when feasible) Day class

Measuring transportation productivity and energy consumption; application of control theory for improving transportation productivity; simulation of energy-conservation policies and effect of such policies on transportation ridership and economics through time; transportation use and energy consumption in relation to urban and rural structures; case studies.

CE 5401. WATER RESOURCES ENGINEERING. (4 cr; prereq 3400 or #, IT or grad student; 3 lect and 3 lab hrs per wk) Day class and Extension class

Introduction to water resources engineering including flow in conduits, pumps, open channels and culverts; introduction to flow measurements, hydraulic structures and systems approach to water resources engineering.

CE 5405. HYDROLOGY AND HYDROLOGIC DESIGN. (4 cr; prereq 5401 or #, IT or grad student; 3 lect and 3 lab hrs per wk) Day class and Extension class

Hydrologic cycle, precipitation, evaporation, infiltration, runoff analysis, flood routing, statistical procedures in hydrology, urban hydrology, introduction to mathematical models of medium and large watersheds, application of hydrology to design of outlet works and flow control structures.

CE 5425. GROUNDWATER MECHANICS. (4 cr; prereq 3400 or #, IT or grad student) Day class

Basic equations. Shallow confined and unconfined flows, two-dimensional flow in the vertical plane, and transient flow. Flow from rivers and lakes toward wells. Determination of streamlines and pathlines in two and three dimensions. Introduction to containment transport. Elementary computer modeling.

CE 5426. COMPUTER MODELING OF GROUNDWATER FLOW. (4 cr; prereq 3400 or #, IT or grad student) Day class

Principles of Analytic Element Method, Boundary Integral Equation Method, Finite Element Method, Finite Difference Method. Applications of these four methods to field problems using existing computer programs. Derivation and interpretation of basic equations for contaminant transport in groundwater. Implementation of transport mechanisms in the various computer models.

CE 5500. ANALYSIS AND DESIGN OF WATER SUPPLY SYSTEMS. (4 cr; prereq 3400 or #, IT or grad student) Joint Day/Extension class

Planning and engineering design considerations in developing water supply systems for urban centers. Supply quality, storage, treatment, distribution, and cost analysis.

CE 5501. ANALYSIS AND DESIGN OF WASTEWATER SYSTEMS. (4 cr; prereq 3400 or #, IT or grad student) Day class

Planning and engineering design considerations in developing waste disposal systems for urban centers. Volumes and quality of waste streams, treatment and ultimate disposal of domestic and industrial wastewaters, and storm water runoff. Environmental effects, cost, and political aspects of ultimate disposal.

CE 5505. WATER QUALITY ENGINEERING. (4 cr; prereq IT or grad student or #) Day class

Chemical and physical properties of natural waters, introduction to aquatic biology, and ecological considerations of element cycling of natural carbon, nitrogen, phosphorus, oxygen, and anthropogenic chemical species (pesticides, PCBs, heavy metals). Physical and chemical processes of water treatment.

CE 5506. ENVIRONMENTAL WATER CHEMISTRY. (4 cr; prereq Chem 1006 or #, IT or grad student; 3 lect and 1 rec hrs per wk) Joint Day/Extension class

Composition of natural waters and wastewater; chemical processes affecting distribution of pollutants and water quality parameters in natural waters; methods of evaluation to determine fate of organic pollutants.

CE 5510. SOLID AND HAZARDOUS WASTE MANAGEMENT. (4 cr) Joint Day/Extension class

Characterization of solid and non-radioactive hazardous wastes and legislation affecting its disposal; processing methods: size reduction, physical separation, chemical separation, biological treatment, combustion and incineration; examples of material recovery and reuse. Emphasis on unit operations and processes associated with recycle and recovery of values.

CE 5515. WATER AND WASTEWATER MICROBIOLOGY. (4 cr; prereq Chem 1005, Math 1231) Joint Day/Extension class

Analysis of role of microbes in environmental degradation and pollution control. Organism growth and selection in wastewater treatment systems. Pathogenic organisms in water supply. System control using microbial based indicators.

CE 5540. ANALYSIS OF GROUNDWATER-SOIL POLLUTION ABATEMENT TECHNOLOGY. (4 cr; prereq 5501, 5401 or #) Day class

Fate of chemicals in groundwater and soils will be analyzed and modeled. Transport, dispersion, chemical-biological transformations and accumulation will be considered. Models will be used to study in situ clean-up of groundwater and aquifers and simulate time dependent changes in pollutant concentration.

CE 8406. SEMINAR: ADVANCED HYDROLOGY. (1 cr) Day class

Weekly seminar by staff, students, and guest speakers.

CE 8419. WATER RESOURCES SYSTEMS SIMULATION. (4 cr, prereq 5401 or #) Day class

Computer simulation of water resource systems, including hydrology systems stream flow and quality systems, economic systems and sociopolitical systems using deterministic and stochastic approaches.

CE 8425. ADVANCED GROUNDWATER MECHANICS. (4 cr; prereq 5425 or #) Day class

Conforma mapping techniques for two-dimensional steady groundwater flow. The hodograph method. Problems involving a free boundary and horizontal drains. Boundary value problems. Application of boundary integral equation techniques.

CE 8430. LAKE AND RESERVOIR HYDRODYNAMICS. (3 cr; prereq #) Day class

Overview of hydrodynamic phenomena, analysis of density stratification, energy and momentum transfer through a water surface, wind effects of stratification and circulation, standing of progressive waves, stratified flow, density currents, selective withdrawal, mixing.

CE 8500. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT. (3 cr; prereq 5500, 5501, or #) Day class

Theoretical principles underlying physical and chemical processes for water and wastewater treatment including sedimentation, flotation, adsorption, precipitation, and disinfection.

CE 8501. PHYSICAL AND CHEMICAL PROCESSES FOR WATER AND WASTEWATER TREATMENT—PART II. (3 cr; prereq 5500, 5501, 5506 or #) Day class

Theoretical principles, design considerations, and performance of processes not covered in CE 8500. Coagulation flocculation, filtration, membrane processes, gas transfer, sludge dewatering, mixing, and other processes commonly used in water pollution control.

CE 8502. BIOLOGICAL AND CHEMICAL PROCESSES FOR WASTEWATER TREATMENT. (3 cr; prereq 5501 or #) Day class

Theoretical principles underlying chemical and biological wastewater treatment processes including aerobic and anaerobic biological processes for carbon and nitrogen removal, aeration, and chemical processes for phosphorus and nitrogen removal.

CE 8505. AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS. (4 cr; prereq Chem 5506 or #) Day class

Application of principles of physical chemistry to quantification of chemical processes in aquatic systems. Natural waters as equilibrium and dynamic systems. Ionic equilibria; protolysis, complexation, solubility, and redox equilibria. Precipitation and mineral dissolution kinetics. Aqueous metal species in electrolyte solutions.

CE 8506. AQUATIC CHEMISTRY FOR ENVIRONMENTAL ENGINEERS. (4 cr; prereq 8505 or #) Day class

Natural interactions with rock and soil, precipitation and atmospheric fallout; industrial and domestic sources. Nature of aqueous metals in term of electrolyte solutions, hydrolysis reactions, complexation, chelation, redox, solubility, and precipitation. Interactions at solid-solution interfaces in terms of phenomenological and general models for adsorption. Hydrodynamic, biological, and chemical factors affecting distribution, transport and removal from aqueous phase. Computer techniques emphasized.

CE 8550. ANALYSIS AND MODELING OF AQUATIC ENVIRONMENTS. (4 cr; prereq #) Day class

Introduction to hydrologic transport and water quality simulation in natural water systems. Mixed cell models, advection, turbulent diffusion and dispersion in one- and two-dimensional systems. Chemical and biological kinetics in water quality models. Applications to temperature, dissolved oxygen, primary productivity, and other water quality management problems in rivers, lakes, and reservoirs. Deterministic versus stochastic models. Water quality dynamics.

CE 8551. SEMINAR: MODELS OF AQUATIC ENVIRONMENTS. (1-5 cr; prereq 8550) Day class

Case studies of specific aquatic streams and lake systems.

CE 8560. SEMINAR: SPECIAL TOPICS IN ENVIRONMENTAL ENGINEERING. (1 cr; prereq #) Day class

Selected environmental engineering topics discussed by students, staff members, and guests.

COMMUNICATION DISORDERS (CDis)

College of Liberal Arts

110 Shevlin Hall, 624-3322
W.D. Ward, 121 Lions' Research Building, 2001 6th St. S.E., 627-4694

CDis 5704. NOISE AND MAN. (4 cr; prereq 5301 or #) Day class

Temporary and permanent effects of steady, intermittent, and impulse noise on hearing and health. Annoyance and community noise. Noise measurement, reduction, and control; ear defenders and their limitations. Hearing conservation programs; preemployment testing and monitoring audiometry.

CONSERVATION BIOLOGY (CB)

Graduate School

307 Johnston Hall, 625-3490
Francie Cuthbert, 320 Hodson Hall, 624-1756

CB 8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES. (3 cr; prereq intro genetics course or #) Day class

Seminar on current conservation biology issues; genetic, demographic, and environmental analysis and management of populations; ecosystem conservation; case studies of species conservation strategies.

DESIGN (Dsgn)

College of Human Ecology

240 McNeal Hall, 624-9700
Delores Ginthner, 491 McNeal Hall, 624-3293

Dsgn 3631. INTERIOR DESIGN RESOURCES AND MATERIALS. (3 cr, § 3557; prereq 1555 or #; TexC 3621) Day class

✿ **new** Resources and materials used in interiors and their functional and aesthetic relationship to interior design. Includes life safety issues.

Dsgn 3633. LIGHTING DESIGN FOR ENVIRONMENTAL SPACES. (3 cr; prereq Phys 1001) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Examination of types and uses of lighting, its relationship to color, and energy conservation. Evaluation of light quantity and quality for residential and non-residential spaces.

DESIGN, HOUSING, AND APPAREL (DHA)

College of Human Ecology

240 McNeal Hall, 624-9700
Becky L. Yust, 240 McNeal Hall, 624-4904

DHA 1101. INTRODUCTION TO THE DESIGNED ENVIRONMENT. (3 cr) Day class

✿ **new** Analysis of the interaction between people and the designed environment, both at the micro and macro levels.

ECOLOGY, EVOLUTION, AND BEHAVIOR (EEB)

College of Biological Sciences

109 Zoology, 625-4466
Franklin H. Barnwell, 109 Zoology, 625-4466

EEB 3001. INTRODUCTION TO ECOLOGY. (4 cr; open to jrs and above but not to biology majors) Day class and Extension class

Basic concepts in ecology; the organization, development, and functioning of ecosystems; population growth and regulation. Human impact on ecosystems.

EEB 3101. ECOLOGY FOR ENGINEERS AND PHYSICAL SCIENTISTS. (4 cr; 3001; not open to biology majors; prereq Math 1241) Joint Day/Extension class: refer to daytime *Class Schedule*

Description and analysis of the spatial and temporal interactions between populations in ecosystems; processes affecting populations; transformations of energy and materials in the biosphere. Lectures and recitations.

EEB 5004. DYNAMICS OF GLOBAL CHANGE: QUATERNARY HISTORY OF ECOSYSTEM RESPONSE. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Events during the Quaternary Ice Age and earlier in Earth's history illustrate the interconnectedness of the biota, atmosphere, continents and oceans, resulting in a dynamic global ecosystem.

EEB 5008. QUATERNARY ECOLOGY. (4 cr; prereq Biol 5041 or 5841 or #; offered 1992-93) Joint Day/Extension class: refer to daytime *Class Schedule*

Impact of changes in the physical and biological environment during the Quaternary period on plants and animals. Changes in evolutionary rates, geographical distributions, community composition and fluctuations in population sizes. Impact of prehistoric human culture on the environment, including ecosystem-level changes recorded in sedimentary sequences. Recent climatic changes. General principles of analysis and methods of investigation and interpretation.

EEB 5014. ECOLOGY OF PLANT COMMUNITIES. (5 cr; prereq Biol 5041 or 5048 or 5841, 1 qtr statistics or #; offered when feasible) Joint Day/Extension class: refer to daytime *Class Schedule*

Methods of describing, sampling, and classifying plant communities; theory of their structure and development, and of the stability of the interactions among their constituent populations. Field trips to examine local vegetation types; analysis of quantitative data.

EEB 5016. ECOLOGICAL PLANT GEOGRAPHY. (5 cr; prereq Biol 5041 or 5841, PBio 3201 [formerly Bot 3201] or ¶PBio 3201 or #; offered 1992-93) Joint Day/Extension class: refer to daytime Class Schedule

Vegetation regions of the world and North America in detail; ecological principles of plant distribution; interpretation of regional and temporal patterns in distribution of vegetation and taxonomic groups. Field trips to floristic regions of Minnesota.

EEB 5051. ANALYSIS OF POPULATIONS. (4 cr; prereq Biol 5041 or 5841 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Factors involved in the regulation, growth, and general dynamics of populations. Data needed to describe populations, population growth, population models, and regulatory mechanisms.

EEB 5122. PLANT/ANIMAL INTERACTIONS. (4 cr; prereq Biol 1106 or 3011, 1103 or 3012 plus 10 credits in biological sciences or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Herbivority, pollination, seed dispersal. Implications of interaction for plants and animals at organismal, population, and community levels. Coevolution.

EEB 5129. MAMMALOGY. (5 cr; FW 5129; prereq Biol 1106 or 3011 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Recent families and orders of mammals of the world and of genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.

EEB 5134. INTRODUCTION TO ORNITHOLOGY. (5 cr; prereq Biol 1106 or 3011) Joint Day/Extension class: refer to daytime *Class Schedule*

Laboratory and field course in structure, classification, distribution, migration, habits, habitats, and identification of birds. Weekend trips scheduled.

EEB 5136. ICHTHYOLOGY. (4 cr; prereq 15 cr incl Biol 1106 or 3011) Joint Day/Extension class: refer to daytime *Class Schedule*

Biology of fishes including development, systematics, anatomy, physiology, and ecology.

EEB 5601. LIMNOLOGY. (4 cr; Geo 5601; prereq Chem 1005 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Description and analysis of the events in lakes, reservoirs, and ponds, beginning with their origins and progressing through their physics, chemistry, and biology. Interrelationships of these parameters and effects of civilization on lakes.

EEB 5606. ECOLOGY OF FISHES. (3 cr; prereq Biol 1106 or 3011, EEB 5136 plus 10 cr in the biological sciences; offered when feasible) Joint Day/Extension class: refer to daytime *Class Schedule*

Ecological requirements of fishes with emphasis on nongame species, habitat, food, interactions among species, and behavioral, anatomical, and physiological adaptations. Fishes in the aquatic ecosystem with emphasis on fresh waters.

EEB 5607. ECOLOGY OF ANIMAL PLANKTON. (4 cr; prereq Biol 5041 or 5841, EEB 5601 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Biology of animal plankton, including distribution of zooplankton in lakes, ecosystem functions such as grazing and remineralization, determination of production, physiological responses to contaminated environments, and important aspects of behavior.

EEB 5608. ECOSYSTEMS: FORM AND FUNCTION. (3 cr; prereq 5601 or Biol 5041 or 5841 or equiv) Joint Day/Extension class: refer to daytime *Class Schedule*

Nature and development of terrestrial wetland and aquatic ecosystems. Analysis of energy flow and element cycling in relation to environmental controls, self-regulation, natural and human disturbances.

EEB 5621. LIMNOLOGY LABORATORY. (2 cr; Geol 5621; prereq EEB 5601 or Geol 5601 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Principal techniques for obtaining information about environmental conditions in lakes and streams. Procedures for measuring the abundance and population dynamics of aquatic organisms, with special emphasis on plankton, field instruments, sampling devices, chemical analyses, microscopy and analysis of data. One Saturday field trip.

COURSES OFFERED AT LAKE ITASCA FORESTRY AND BIOLOGICAL STATION

EEB 5814. PLANT COMMUNITY ECOLOGY. (5 cr; limited to 20 students; prereq course in ecology; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Communities represented in Itasca Park and vicinity, with emphasis on vegetation. Patterns of distribution of the communities, their interaction with the environment, and their dynamic relationships. Methods of community description and analysis.

EEB 5817. VERTEBRATE ECOLOGY. (5 cr; prereq course in ecology, Δ; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Field studies on populations and their relationships to local environments; habitat analysis and ecological research methods. All students will work as a team investigating factors influencing the distribution and abundance of selected vertebrates in various habitats. This is a research-oriented course supplemented with lectures and field trips.

EEB 5834. FIELD ORNITHOLOGY. (5 cr; prereq course in general biology including study of zoology; Δ; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Emphasis on the breeding season, biology, behavioral ecology of birds in the Itasca region. Field trips taken to a variety of habitats to learn bird identification and observe and practice techniques for conducting field studies. Laboratory sessions investigate family distinctions and species identification. Individual field projects. Designed primarily for students with fisheries and wildlife management interests. (Lab charge required)

ECONOMICS (Econ)

College of Liberal Arts

1035 Management and Economics, 625-6353
Director of Undergraduate Programs, 1035 Management and Economics, 625-6353

Econ 5611. RESOURCE AND ENVIRONMENTAL ECONOMICS. (4 cr; prereq 3101 or equiv, 1 qtr calculus) Day class

Exhaustible resources and the theory of optimal depletion. Renewable resources and the theory of optimal use. Will resource scarcity limit growth? Natural resources and natural environments. Environmental pollution and economic efficiency.

ELEMENTARY EDUCATION (Elem)

College of Education

125 Peik Hall, 625-6372
Pat Williamson, 125 Peik Hall, 625-4044

Elem 5348. WORKSHOP: OUTDOOR SCIENCE EDUCATION. (3 cr; prereq elementary teaching experience, A-F only) Joint Day/Extension class

Classroom and fieldwork activities dealing with models, materials, and methods in the outdoor setting; consideration of broad topics such as ecological relationships, cyclic processes, and change as well as more specific topics such as rocks and minerals, plants and animals, and stargazing.

ENTOMOLOGY (Ent)

College of Agriculture

219 Hodson Hall, 624-3636
David W. Ragsdale, 416 Hodson Hall, 624-3636

Ent 1005. ECONOMIC ENTOMOLOGY. (4 cr; prereq Biol 1009 or #) Day class

Brief introduction to structure and classification of insects; management of insect populations; life histories, habits, and recognition of insect pests of livestock, orchards, field crops, vegetables, and ornamentals.

Ent 3005. INTRODUCTORY ENTOMOLOGY. (5 cr; prereq Biol 1009 or equiv) Day class

General morphology, life histories, habits, and classification of insects.

Ent 5040. INSECT ECOLOGY. (3 cr; prereq Biol 5041 or EBB 5122 or #) Day class

Synthetic analysis of the causes of insect diversity and of fluctuations in insect abundance. Focus on abiotic, biotic and evolutionary mechanisms influencing insect populations and communities.

Ent 5210. INSECT PEST MANAGEMENT. (4 cr; prereq 1005 or #) Day class

Management of insect, mite, and weed populations through integration of various methods and techniques.

Ent 5250. FOREST ENTOMOLOGY. (4 cr; prereq any two courses among the forestry, zoological, botanical, biological and/or agricultural sciences) Day class

Lectures and laboratory concerning ecology and population management of forest insects, with heavy emphasis on tree factors and biological control.

Ent 5280. LIVESTOCK ENTOMOLOGY. (3 cr) Day class

Biology and management of arthropods that affect livestock production systems.

Ent 5320. ECOLOGY OF AGRICULTURE. (4 cr; prereq two 3000 or above level courses in agronomy, horticulture or animal science, and two 3000 or above level courses in entomology, plant pathology or soil science or #) Day class

Ecological perspective on post-industrial agriculture. Discussions on the origins of agriculture and comparison of the function and ecology of contemporary and extinct agricultural systems.

Ent 5600. FIELD ENTOMOLOGY. (5 cr; prereq introductory biology; offered SSI at Itasca) Day class

Insect fauna in various natural habitats of the park and surrounding areas. Includes field trips and collection and identification of insects, as well as studies of general morphology, life histories, and habitats of local species.

Ent 5610. AQUATIC ENTOMOLOGY. (5 cr; prereq 3005 or 5600 or equiv or #; given at Itasca) Day class

Identification and biology of aquatic and littoral insects in all stages.

Ent 8240. COLLOQUIUM IN INSECT ECOLOGY. (3 cr; prereq 5040 or #) Day class

Dispersal, distribution, abundance, natural control and related problems.

ENVIRONMENTAL AND OCCUPATIONAL HEALTH (PubH)

School of Public Health

1155 Mayo Memorial Building, 626-0900
Kathryn Buxton, 1260 Mayo, 626-0900

PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: PRINCIPLES OF ENVIRONMENTAL HEALTH LAW. (1 cr; Wint Spec Term, Sec 1) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Among topics included are legal aspects of environmental decision making, legal processes, jurisdiction, and tort law.

PubH 5150. TOPICS IN ENVIRONMENTAL HEALTH: POLLUTION CONTROL LAW. (1 cr; prereq 5150, Sec 1; Spring Spec Term, Sec 3) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Among topics included are Federal Clean Air Act, Clean Water Act, RCRA, TOSCA, and FIFRA.

PubH 5151. ENVIRONMENTAL HEALTH. (3 cr; prereq #) Extension class

Methods for promoting human health and comfort by controlling environment.

PubH 5152. ENVIRONMENTAL HEALTH. (2 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

General principles of environmental health relating to macro and micro environments and products consumed or used by people.

PubH 5153. CASE STUDIES IN ENVIRONMENTAL HEALTH. (2 cr; prereq EH student and concurrent registration in PubH 5152 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Current applications of environmental health principles and practices. Relation of past didactic work to real-life problems encountered by environmental health professionals.

PubH 5155. ISSUES IN ENVIRONMENTAL AND OCCUPATIONAL HEALTH. (2 cr; prereq PH or grad student, or #) Joint Day/Extension class: refer to daytime *Class Schedule*

The field, the current issues, and the principles and methods of environmental and occupational health protection. Independent field visits to observe, review and analyze environmental/occupational health programs is required.

PubH 5158. HEALTH RISK EVALUATION. (3 cr; prereq EH majors or #) Joint Day/Extension class: refer to daytime *Class Schedule*

General principles of health risk assessment and management; environmental pollutants; public domain and workplace, legislation and regulations.

PubH 5171. ENVIRONMENTAL MICROBIOLOGY. (4 cr; prereq MicB 3103 or #; offered alt yrs) Joint Day/Extension class: refer to daytime *Class Schedule*

Survival, dissemination, monitoring, and significance of microorganisms in the environment; application of principles to environmental health problems.

PubH 5181. AIR POLLUTION. (4 cr; prereq 2 yrs chemistry, calculus, general physics or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Overview of current air pollution problems; sources of pollution, gas phase and aerosol phase chemistry, fate of pollutants, and human health and materials effects.

PubH 5184. AIR ANALYSIS. (3 cr; prereq 5211, #) Joint Day/Extension class: refer to daytime *Class Schedule*

Laboratory and field exercises involving air flow calibration, dynamic calibration of field equipment for analysis of air contaminants, respirable mass sampling, dust counting and sizing, and instrumentation for measuring physical environmental stresses.

PubH 5186. ENVIRONMENTAL CHEMISTRY. (3 cr; prereq general chemistry and organic chemistry or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Chemistry of atmosphere, water and soil; environmental behavior and fate of pollutants.

PubH 5201. RADIATION PROTECTION AND MEASUREMENT. (2 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Ionizing radiation sources, detection and measurement, protection principles, health implications.

PubH 5202. RADIATION LABORATORY. (1 cr; prereq 5201 or concurrent with 5201) Joint Day/Extension class: refer to daytime *Class Schedule*

Laboratory for 5201.

PubH 5212. VENTILATION CONTROL OF ENVIRONMENTAL HAZARDS. (3 cr; prereq 5211 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Theory and application of exhaust ventilation in control of airborne environmental hazards: principles of air movement and mixing, design of appropriate ventilation controls, and techniques for measuring and evaluating controls. This course is designed for environmental health, engineering, and other students interested in industrial hygiene.

PubH 5233. BIOLOGICAL SAFETY. (2 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Topics include: assessment of risk; primary barriers, laboratory design criteria, safety devices and equipment; personnel practices; sterilization and decontamination; laboratory animals; and shipping and disposal of biohazardous agents.

PubH 5239. MICROBIOLOGY OF THE HUMAN ENVIRONMENT: SEMINAR. (1 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Topics of current research interest on infectious disease and injury prevention through environmental intervention.

PubH 5242. ENVIRONMENTAL HEALTH ASPECTS OF GROUNDWATER SYSTEMS. (2 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Groundwater geology, quality, and treatment; well design, contruction and maintenance; special references to public and environmental health problems.

PubH 5243. WATER AND HEALTH. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Occurrences, health effects, and treatment of physical, chemical and biological agents in transmission of waterborne diseases.

PubH 5253. INTRODUCTION: HAZARDOUS WASTE MANAGEMENT. (3 cr) Joint Day/Extension class

Review of roles of public and private sectors as generators, disposers and regulators of hazardous wastes. Includes definitions, sources, transportation, handling, treatment, recovery, disposal, and public health implications.

PubH 5254. HAZARDOUS WASTE MANAGEMENT. (1 cr) Joint Day/Extension class: refer to daytime *Class Schedule.* Offered at the Summer Occupational Health and Safety Institute.

Overview of problems and possible solutions. Technical, political, social, economic and regulatory factors are included.

PubH 5261. GENERAL ENVIRONMENTAL TOXICOLOGY. (3 cr) Joint Day/Extension class

Application of basic biochemical, anatomical, and physiological principles to environmental toxicology; assessment of potential health hazards; approaches to solution of toxic problems.

PubH 5267. ENVIRONMENTAL AND OCCUPATIONAL TOXICOLOGY. (3 cr; not open to students with subspecialty in toxicology) Joint Day/Extension class: refer to daytime *Class Schedule* . Offered at the Summer Occupational Health and Safety Institute.

Basic principles of toxicology (absorption, distribution, metabolism, excretion, and site of action); tissue specificity of chemical injury.

PubH 8185. ANALYSIS OF TOXICANTS. (3 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Application of principles of analytical chemistry to analysis of toxic chemicals in tissues and fluids, environment, workplace, and environmental health research: survey of instrumental methods (gas and liquid chromatography, mass spectrometry, and atomic and molecular spectroscopy); interpretation of results; analytical quality control.

FISHERIES AND WILDLIFE (FW)

College of Natural Resources

200 Hodson Hall, 624-3600
Ira Adelman, 204 Hodson Hall, 624-4228

FW 1001. ORIENTATION IN FISHERIES AND WILDLIFE. (1 cr; S-N only) Joint Day/Extension class: refer to daytime *Class Schedule*

Survey of technical requirements and training of fishery and wildlife technicians and scientists; introduction to fields of work, problems and career outlets.

FW 1002. WILDLIFE: ECOLOGY, VALUES AND HUMAN IMPACT. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Controversial issues imvolving specific wildlife management principles and techniques. Designed for students without natural science background who are interested in wildlife management issues.

FW 1101. ETHICS AND VALUES IN RESOURCE MANAGEMENT. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Coverage of various aesthetic, economic and ecological values of wildlife and fisheries resources. Class discussions will be directed at understanding the process and ethics of resource management.

FW 3052. INTRODUCTION TO FISHERIES AND WILDLIFE. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Introduction to general ecological principles applied to management of fish and wildlife populations and their habitats; survey of legislation, agencies and policy affecting vertebrate populations; natural history of important Minnesota game and nongame vertebrates.

FW 3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT. (2 cr; offered at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.

FW 3600. FISHERIES AND WILDLIFE FIELD TECHNIQUES. (5 cr; FW 3052; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

An introduction to a variety of field techniques and skills; planning and implementing field projects; data collection and analysis using microcomputers; written reports and a field journal.

FW 5129. MAMMALOGY. (5 cr; EBB 5129; prereq Biol 1106 or 3001 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Recent families and orders of mammals of the world and genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.

FW 5455. AQUACULTURE. (3 cr; prereq Biol 1009, 1103, 1106 or equiv, Chem 1001-2 or 1004-5 or equiv or #; offered alt yrs) Joint Day/Extension class: refer to daytime *Class Schedule*

Role of aquaculture in resource management and world food production; institutional and economic considerations; principles of husbandry of aquatic organisms; interactions between fish metabolism and water quality; nutrition and energetics; fish health and genetics.

FW 5459. PHYSIOLOGY AND BEHAVIOR OF FISH. (4 cr; prereq EEB 5136 or EEB 5156 or FW 5455 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Relationships between the physiology of fishes, their behavior and the aquatic environment. Includes examination of ionic and osmotic balance, gas exchange, locomotion, orientation and migration, reproduction, endocrinology, growth and stress.

FW 5460. POLLUTION IMPACTS ON AQUATIC SYSTEMS. (3 cr; prereq Bio 5041, EEB 5601 and Chem 1004, 1005, 3301, 3305 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Pollution assessment approaches, biological effects, fate and flow of contaminants in aquatic systems, and major types of pollutants will be described.

FW 5461. THE BEHAVIOR OF FISHES. (2 cr; prereq EEB 3111 or FW 5459 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Organismal and sub-organismal perspectives of behavior of fish. Topics include feeding behavior of fish and optimal foraging theory; learning and intelligence in fish; genetic basis of behavior; neural and endocrine bases of behavior; communication, orientation and navigation; schooling and shoaling; reproduction; and the application of an understanding of fish behavior to the harvest, management and conservation of fishes.

FW 5570. AVIAN CONSERVATION AND MANAGEMENT. (4 cr; prereq grad or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Current problems in avian conservation and management, with emphasis on non-game, wetland, and game birds.

FW 5601. ASSESSMENT AND MANAGEMENT OF VERTEBRATE POPULATIONS. (5 cr; prereq Math 1142 or 1211 and PubH 5450 or equiv) Joint Day/Extension class: refer to daytime *Class Schedule*

Conceptual models of populations, description of population characteristics and computer-assisted estimation of population parameters for the purpose of management. Competency in microcomputer word processing and spreadsheet data entry required.

FW 5603. ECOLOGY AND MANAGEMENT OF FISH AND WILDLIFE HABITATS. (4 cr; prereq 5601 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Ecological analysis of environmental factors as they influence distribution, abundance, and productivity of terrestrial and aquatic vertebrates. Emphasis is placed on those factors which humans do or can influence. Three or four all-afternoon and/or Saturday morning field trips.

FW 5604. FISHERY AND WILDLIFE MANAGEMENT. (4 cr; prereq FW 5601 or #) Day/Extension class: refer to daytime *Class Schedule*

Basic understanding of fisheries and wildlife management with an emphasis on managed species of interest. Introduction to tactics and strategies of fisheries and wildlife management. Understanding of the role of strategic planning in directing and redirecting management actions and familiarity with the tools of fisheries and wildlife management and assessment of their efficacy.

FW 5620. GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR FISHERIES, WILDLIFE, AND BIOLOGICAL CONSERVATION. (4 cr; prereq Biol 5041) Day class

Hands on experience with GIS as a tool for understanding analysis and management of ecological systems. Students will learn ARC-INFO and apply it to problems in fisheries, wildlife, and biological conservation.

FOREST RESOURCES (FR)

College of Natural Resources

115 Green Hall, 624-3400
Alan Ek, 204 Green Hall, 624-3400

FR 1001. FOREST RESOURCES ORIENTATION. (1 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Information about curricula offerings, areas of emphasis, CLE requirements, and summer job and internship programs.

FR 1100. DENDROLOGY. (4 cr; prereq Biol 1103) Joint Day/Extension class: refer to daytime *Class Schedule*

Identification, nomenclature, classification, and distribution of about 200 important forest trees. Preparation and use of keys, systems of natural classification, and field and lab methods of identification.

FR 1200. INTRODUCTION TO FOREST RESOURCES. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Multiple forest resources and their management. History, policy, and current issues in forest resources. Lectures and laboratory.

FR 1201. CONSERVATION OF NATURAL RESOURCES. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Development of thought on natural resource conservation in the United States. Renewable resources and their management problems; resource conservation and environmental management related to basic ecological principles.

FR 1202. FARM AND SMALL WOODLANDS FORESTRY. (3 cr for non-forestry majors, 2 cr for majors [3 cr with paper]; prereq for majors 1100 or ¶1100) Joint Day/Extension class: refer to daytime *Class Schedule*

Status and problems of the small woodland owner. Factors influencing tree growth. Cutting practices for and marketing products of small woodlands. Establishment and care of plantations, shelterbelts, and windbreaks. Field trips.

FR 1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES. (3 cr; 1201; for non-forestry students) Joint Day/Extension class: refer to daytime *Class Schedule*

Ecological, social, and economic implications of Minnesota's soil, water, forest, wildlife, and other resources are studied in field exercise and group discussions at nature centers and natural areas. Environmental teaching techniques for the elementary indoor classroom.

FR 3100. IMPORTANT FOREST PLANTS. (1 or 2 cr; prereq Biol 1103; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Identification of forest plants as related to forest types.

FR 3101. NORTHERN FOREST ECOSYSTEMS. (3 cr; prereq Chem 1001 or Chem 1004; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Field examination of succession, soils, silvical characteristics, tree classification, stand structure, and the ecology of regeneration.

FR 3103. METEOROLOGY AND CLIMATOLOGY FOR RESOURCE MANAGERS. (2 cr; prereq Phys 1001, Phys 1005 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Fundamentals of meteorology and climatology as applied to wildland resource management.

FR 3104. FOREST ECOLOGY. (3 cr; prereq Itasca session) Joint Day/Extension class: refer to daytime *Class Schedule*

Ecological concepts and principles as a basis for silvicultural practice. The forest as an ecosystem.

FR 3106. IMPORTANT PLANTS: FISHERIES AND WILDLIFE HABITATS. (1 cr; prereq FW 3600 or ¶3600; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Field identification of important plants in fisheries and a wildlife habitat.

FR 3107. FOREST ECOLOGY LABORATORY. (1 cr; §3101, 3104) Day class

✿ **new** Field trips to introduce forest stands, communities, and ecosystems.

FR 3110. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Selected topics in natural resources.

FR 3201. FIELD FOREST MEASUREMENTS. (1 cr; prereq Math 1008; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Introduction to land survey, tree and stand measurement, and basic forest sampling techniques.

FR 3225/5225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the adviser for the project, a prospectus, and completes progress reports on his or her project.

FR 3250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2 cr; also offered as FR 5200) Joint Day/Extension class: refer to daytime *Class Schedule*

International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overviews of issues and case studies.

FR 3300. ELEMENTS OF SURVEYING. (2 cr; prereq Math 1008 or high school trigonometry; given at Cloquet Forestry Center 1 week prior to fall quarter) Joint Day/Extension class: refer to daytime *Class Schedule*

Basic concepts of elementary plane surveying for use in natural resource assessment. Introduction to public land and boundary surveys and geographic information systems. Lectures and labs.

FR 5100. SILVICULTURE. (4 cr; prereq Itasca session, 1100) Joint Day/Extension class: refer to daytime *Class Schedule*

Introduction to silvics, forest regeneration and site preparation techniques, intermediate silvicultural practices, and silvicultural systems.

FR 5101. FIELD SILVICULTURE. (3 cr; prereq 5100; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Regeneration surveys, plantation inspection, site preparation, and reforestation prescription. Practice in marking for thinning and determining effect on stands. Compartment examination and prescription. Written and oral reports.

FR 5104. FOREST ECOLOGY. (3 cr; prereq one course in biology or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Ecological concepts and principles as a basis for conservation and management of forest ecosystems.

FR 5106. SENIOR SILVICULTURE SEMINAR. (2 cr [3 cr with research paper]; prereq senior, FR 5100, or #; A-N only) Joint Day/Extension class: refer to daytime *Class Schedule*

Students prepare, present, and critique seminars on silvicultural topic of interest. Guest speakers.

FR 5110. FORESTRY APPLICATIONS OF MICRO-COMPUTERS. (3 cr; prereq Stat 3011 and AgEt 3030 or equiv) Joint Day/Extension class: refer to daytime *Class Schedule*

Use of microcomputer software to solve forestry problems, applications programming, working of hardware components. Hands-on access to microcomputers as well as lectures.

FR 5114. FOREST HYDROLOGY. (3 cr; prereq Itasca session, 3103, Geo 1001 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Introduction to the hydrologic cycle and hydrologic processes. Effects of forest management activities on water yield, storm flow, and water quality.

FR 5115. FOREST HYDROLOGY, FIELD APPLICATIONS. (2 cr; prereq 5114 or #; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Use of hydrologic instrumentation to measure precipitation, streamflow, infiltration capacity, soil moisture, air temperature, evaporation, and selected water quality constituents. Collection and interpretation of hydrologic information to evaluate forest-use impacts on water quantity and quality.

FR 5120. INTRODUCTORY TREE PHYSIOLOGY AND GENETICS. (4 cr; prereq Chem 1001 or 1004, 10 cr Biol) Joint Day/Extension class: refer to daytime *Class Schedule*

Genetic variation in forest trees, underlying causes, use. Tree growth, nutrition, and water relation. Environmental and internal regulation of growth. Plant biochemistry and photo-chemistry. Physiology related to silviculturally and ecologically significant phenomena.

FR 5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS. (2 cr; prereq 1122, 5100; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Field examination of forest soils and their relationship to site productivity and forest management.

FR 5130. GEOGRAPHIC INFORMATION SYSTEMS IN NATURAL RESOURCE ANALYSIS. (2 cr; prereq grad or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Provides an introduction to the application of Geographic Information Systems (GIS) to natural resource and regional planning studies. Theory and technical points covered, emphasis on applications. Hands-on experience on microcomputer. Case study is performed, including map digitizing, data processing, and generation of map products.

FR 5152. FOREST GENETICS. (3 cr; prereq sr or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Genetic variation of forest tree species and underlying principles; application of plant breeding principles to forestry.

FR 5153. ADVANCED FOREST HYDROLOGY. (4 cr; prereq 3220, 5114 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Current hydrologic problems in the management of forested watersheds. Analytical methods to evaluate effects of vegetation management on the quantity and quality of runoff. Lecture and laboratory.

FR 5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS. (3 cr; prereq grad only; given at Itasca) Joint Day/Extension class: refer to daytime *Class Schedule*

Plant identification, plant dynamics, land survey, tree measurement.

FR 5200. AERIAL PHOTO INTERPRETATION. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Types, characteristics, procurement, preparation, viewing, and interpretation of color, black-and-white, and color infrared aerial photographs; basic aerial photography; introduction to mapping; applications to resource surveys.

FR 5212. NATURAL RESOURCES INVENTORY. (3 cr; prereq Itasca session, AgET 3030 or equiv computer programming course with FORTRAN or BASIC language, Math 1142 or Math 1211, Stat 3011 or Stat 5021) Joint Day/Extension class: refer to daytime *Class Schedule*

Measurement of stand variables, forest products, forest growth and yield. Elementary statistics. Sampling methods for estimating characteristics of natural resources and resources use for management decision making. Lecture and laboratory.

FR 5215. FOREST FIRE MANAGEMENT. (2 cr; prereq FR 1100, Itasca session, 3103, 5100, or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Concepts, principles, and techniques of fire control and use in wildland management.

FR 5220. REMOTE SENSING, FOREST RESOURCES INVENTORY. (4 cr; prereq FR 5200, 5212; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Use of aerial photographs in property boundary location; interpretation and classification of forest vegetation types. Application of sampling methods for estimating natural resources and resource use for management decision making.

FR 5221. PLANT MOLECULAR EVOLUTION. (3 cr; prereq Biol 5003 or GCB 3022 or GCB 5022; equiv to PBiol 5221) Joint Day/Extension class: refer to daytime *Class Schedule*

Experimental molecular techniques applicable to evolutionary studies. Molecular methods of quantifying genetic diversity. Statistical methods for phylogenetic reconstruction. Application of RFLPs to the study of morphological evolution. Evolution of organellar gonomes. Evolution of multigene families. Role of transposable elements in plant evolution. DNA sequence evolution. Molecular aspects of development as related to plant evolution.

FR 5226. FOREST ECONOMICS AND PLANNING. (5 cr; prereq FR 5212, AgEc 1030 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Conduct and interpretation of economic analysis, forest planning concepts, principles and techniques of forest regulation.

FR 5231. RANGE MANAGEMENT. (3 cr; prereq Biol 1103 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Important range plants; range livestock; range management methods and improvements; public grazing land administration; relationship of livestock grazing to wildlife, forest, watershed, and recreation management on public and private range lands.

FR 5232. MANAGEMENT OF RECREATIONAL LANDS. (4 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Recreational use of the forest and associated land and water. Policy problems arising form recreational demands.

FR 5233. PRINCIPLES OF OUTDOOR RECREATION PLANNING. (4 cr; prereq 5232 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

For advanced students associated with design, management, and planning of recreational facilities. Planning and design principles related to recreational land use and development; parks campsites, water areas, highways, summer and winter recreational facilities.

FR 5236. FOREST RECREATION PLANNING. (1 cr; prereq 5232; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

Recreation area and site planning, examples and managerial concerns. Field work and presentation.

FR 5240. NATURAL RESOURCE POLICY AND ADMINISTRATION. (3 cr; prereq sr in forestry or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Basic concepts of political and administrative processes in development of natural resource policies and programs. Policy processes, agenda setting, political decision rules, strategies for achieving agreement, participants in policy development, public means of implementing policies and case examples.

FR 5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES. (3 cr; prereq FR 5240 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Advanced concepts of political and administrative processes important to the development of natural resource policies and programs. Issue creation and agenda setting theories, incremental decision-making styles, role of analysis and analytical information, actions of major policy participants (e.g., courts, legislatures, interest groups, media), program planning, budgeting and staffing, and evaluation of natural resource case studies.

FR 5248. HARVESTING AND ENGINEERING. (3 cr; prereq CE 3100; given at Cloquet) Joint Day/Extension class: refer to daytime *Class Schedule*

An introduction to harvesting systems, relationship to forest management, and preparation and administration of timber sales. Fundamentals of location, construction, and maintenance of forest roads.

FR 5250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overviews of issues and case studies. Term paper, other requirements.

FR 5257. RECREATION LAND POLICY. (3 cr; prereq 5232 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Policy issues affecting the use and management of lands devoted entirely or in part to recreational objectives.

FR 5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR. (3 cr; prereq 5232, RRM major or grad student or #; offered alt years beginning 1992) Joint Day/Extension class: refer to daytime *Class Schedule*

Development of environmental framework for understanding recreation behavior. Contributions of several disciplines, current cultural trends, management implications.

FR 5262. REMOTE SENSING OF NATURAL RESOURCES. (4 cr; offered alt yrs beginning 1993) Joint Day/Extension class: refer to daytime *Class Schedule*

Introduction to remote sensing for natural resource inventories, land use analyses, and environmental monitoring activities; photographic, thermal, multispectral, and radar sensing procedures; airborne and satellite systems; visual and computer-assisted analysis techniques; oriented toward an interdisciplinary audience.

FR 5264. QUANTITATIVE TECHNIQUES IN FOREST MANAGEMENT. (3 cr; prereq FR 5212, 5226 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Forestry applications of quantitative techniques in allocation and other decision-making problems. Mathematical programming, simulation, and other techniques.

FR 5401. SENIOR TOPICS. (ar cr; prereq sr in forestry or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Independent study in a field of interest to the student. Work must be planned with a forestry faculty member.

FR 5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION. (3 cr) Joint Day/Extension class

Intended for elementary school teachers. Study of soil, water, forest, and wildlife resources of Minnesota and the biological principles and ecological implications of management.

FR 5412. ADVANCED REMOTE SENSING. (4 cr; prereq FR 5262 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Working knowledge of quantitative remote sensing. Both theoretical basis and practical aspects, including energy-matter interactions, radiation measurements and sensors, and digital analysis.

FR 5460. WATER QUALITY: THE INTERNATIONAL DIMENSION. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Water quality management practices and policies in rapidly changing societies; emphasis on developing countries.

FR 5500. URBAN FOREST MANAGEMENT. (3 cr; prereq 5100 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Discussion and development of basic concepts. Introduction to terminology and principles of urban tree inventory, propagation, and care; management case studies; equipment operation and costs.

FR 5703. COLLOQUIUM IN NATURAL RESOURCES. (1-2 cr; prereq varies with topic or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Colloquium on specialized topics in forest biology, silviculture, and related resource management.

FR 8100. RESEARCH PROBLEMS: SILVICULTURE. (ar cr) Day class

FR 8101. RESEARCH PROBLEMS: FOREST TREE PHYSIOLOGY. (ar cr) Day class

FR 8102. RESEARCH PROBLEMS: FOREST TREE GENETICS. (ar cr) Day class

FR 8103. RESEARCH PROBLEMS: FOREST HYDROLOGY. (ar cr) Day class

FR 8104. RESEARCH PROBLEMS: FOREST ECOLOGY. (ar cr)
✿ **new** Day class

FR 8105. ADVANCED FIELD SILVICULTURE. (3 cr; prereq FR 5101, #) Day class

Selected current problems and research in silviculture. Plant-soil relationships with particular reference to forest soils. Methods of forest soil investigations in the field and laboratory.

FR 8106. TOPICS IN SILVICULTURE—FOREST SOILS. (ar cr; prereq FR 5100 and 5 cr in soils or #) Day class

FR 8108. FOUNDATIONS OF RENEWABLE RESOURCES RESEARCH. (3 cr) Day class

FR 8200. RESEARCH PROBLEMS: FOREST MANAGEMENT. (ar cr) Day class

FR 8201. RESEARCH PROBLEMS: FOREST ECONOMICS. (ar cr) Day class

FR 8202. RESEARCH PROBLEMS: FOREST MEASUREMENTS. (ar cr) Day class

FR 8203. RESEARCH PROBLEMS: FOREST RECREATION. (ar cr) Day class

FR 8204. RESEARCH PROBLEMS: FOREST POLICY. (ar cr) Day class

FR 8205. RESEARCH PROBLEMS: REMOTE SENSING. (ar cr) Day class

FR 8206. ADVANCED MANAGEMENT OF RECREATIONAL LANDS. (3 cr; prereq FR 5233, EBB 3004 or #) Day class

Relationship of people as recreationists to the natural environment. Principles of manipulation of plant and animal communities for outdoor recreation objectives. Lectures, readings, discussions, reports, field trips.

FR 8207. ECONOMIC ANALYSIS OF FORESTRY PROJECTS. (3 cr; prereq #) Day class

Public and private forestry projects; analysis of commercial profitability and application of benefit-cost analysis; preparation of feasibility studies; case studies.

FR 8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES. (3 cr) Day class

Identification and analysis of major international, national, and state issues of importance to natural resource management. Review of literature, case studies, and guest speakers.

GENERAL COLLEGE (GC)

340 Appleby Hall, 625-5529
Jay Hatch, 340 Appleby Hall, 625-9346

GC 1111. SCIENCE IN CONTEXT: WEATHER AND CLIMATE. (5 cr; 5 lect, 1 lab hrs per wk) Day class and Extension class

Weather patterns; interactions among atmosphere, oceans, land surfaces, and earth motion. Storms, seasonal change, climatic change, fair weather, air pollution, and distribution of moisture and energy from theoretical and applied viewpoints. Scientific principles applied to analyzing and forecasting weather, interpreting climates and climatic change, and understanding individuals' interaction with atmospheric environment.

GC 1112. ECOLOGICAL EVALUATION OF ENVIRONMENTAL PROBLEMS. (5 cr) Day class and Extension class

Concepts of ecology (organization of ecosystems, material cycling, energy flow and production, population dynamics, and community interaction) needed to understand proximate and ultimate causes of environmental problems such as world hunger, endangered species, deforestation, solid and hazardous wastes, global climate change, acid rain, and cultural eutrophication. Frameworks and methodologies for critically evaluating impacts and proposing interventions.

GC 1133. NATURE STUDY. (4 cr; 4 hrs integrated lecture, laboratory and field work) Extension class

✿ **new** General natural history for students with little or no prior training in biology. Common Minnesota plants and animals examined in the field from the viewpoint of the informed amateur naturalist. Natural habitat associations; field observation and identification techniques.

GC 1171. PHYSICAL GEOLOGY. (5 cr; 5 lect, 3 or more lab hrs per wk) Day class

Description and development of common land features—valleys, mountains, rivers, lakes. Processes responsible for their origin and change. Types of surface materials. Movements inside earth and their effects on its surface. Self-paced laboratory: mineral and rock analysis, topographic map reading, landform identification, landscape interpretation.

GC 1173. GEOLOGY OF THE NATIONAL PARKS. (5 cr; 5 hrs integrated lecture and laboratory) Day class

✿ **new** Processes that produced spectacular scenic and geologic features of North America's national parks and monuments, described using a regional approach. Basic geology introduced as needed.

GENETICS AND CELL BIOLOGY (GCB)

College of Biological Sciences

250 Biological Sciences Center, 624-3003
Kathleen Peterson, 223 Snyder Hall, 624-9717

GCB 3002. HUMAN GENETICS, SOCIAL AFFAIRS. (3 cr [4 cr with paper], 3022 or Biol 1101, Biol 5003; for students in programs not directly related to biological sciences) Extension class

Human genetics; study of individuals, families, populations, and races with respect to differences in intelligence, behavior, disease, and other matters of social concern.

GEOGRAPHY (Geog)

College of Liberal Arts

414 Social Sciences, 625-6080
R. Skaggs, 568 Social Sciences, 625-6643

Geog 1401. PHYSICAL GEOGRAPHY. (5 cr; NSci 1501) Joint Day/Extension class: refer to daytime *Class Schedule*

Distribution patterns of climate, relief, vegetation, and soils, regional differences in problems of physical development.

Geog 1425. INTRODUCTION TO METEOROLOGY. (4 cr; Soil 1262) Joint Day/Extension class: refer to daytime *Class Schedule*

(Same as Soil 1262) The atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns, meteorological instruments and observation; plotting and analysis of maps; forecasting.

Geog 3361. LAND USE AND THE FEDERAL GOVERNMENT. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

The statutory and regulatory framework in which individuals choose to use land in the United States; the federal role in creating the framework.

Geog 3362. LAND USE AND STATE GOVERNMENT. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

The statutory and regulatory framework in which individuals choose to use land in the United States; the state's role in creating the framework.

Geog 3421. CLIMATOLOGY. (4 cr; prereq 1401 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

World distribution of climatic elements; methods of arranging climatic data; climatic classifications and world distributions of climatic types; general circulation; climatic change and climatic fluctuations.

Geog 3431. INTRODUCTION TO PLANT AND ANIMAL GEOGRAPHY. (4 cr; not open to biology majors) Joint Day/Extension class: refer to daytime *Class Schedule*

World distribution of plants and animals; biological and ecological background; the geographical picture; the paleoecological record.

Geog 5361. LAND IN AMERICA. (4 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Land ownership in the United States.

Geog 5424. APPLIED CLIMATOLOGY. (3 cr; Soils 5424; prereq Geog 3421 or Soils 5420 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Application of climatic principles and data to selected problems in environmental management and agriculture.

Geog 5441. QUATERNARY LANDSCAPE EVOLUTION. (4 cr; prereq Geog 1401 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Examination of the roles of geomorphic history, climate change, soil development, and vegetation change in the evolution of landscape patterns during the Quaternary, with emphasis in North America.

Geog 5444. GEOGRAPHY OF WATER RESOURCES. (4 cr; prereq two courses in physical geography or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Distributional aspects of the magnitude, quality, and dynamics of water resources. Aesthetic, recreational, and material production uses of water; consequences of human actions in the hydrosphere, especially in fresh water.

Geog 8340. SEMINAR: LAND USE PLANNING. (3 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Geog 8344. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA. (1 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Geog 8345. SEMINAR: PUBLIC LAND POLICY IN MINNESOTA. (3 cr; prereq 8344) Joint Day/Extension class: refer to daytime *Class Schedule*

Geog 8420. SEMINAR: CLIMATOLOGY. (1-3 cr; prereq #) Joint Day/Extension class: refer to daytime *Class Schedule*

Detailed study of selected topics. Topics vary from year to year; examples include modeling, climatic variability, predictability, severe local storms, drought, and energy balance.

GEOLOGY AND GEOPHYSICS (Geo)

Newton Horace Winchell School of Earth Sciences

Institute of Technology

106 Pillsbury Hall, 624-1333
H.O. Pfannkuch, 2D Pillsbury Hall, 624-1620

Geo 1001. THE DYNAMIC EARTH: AN INTRODUCTION TO GEOLOGY. (4 cr; 4 lect hrs) Day class and Extension class

A nonmathematical introduction to earth, its internal structure; processes that shape its surface; theory of plate tectonics; action of streams, glaciers, waves, wind, and groundwater; limnology; fossil fuels and mineral deposits; environmental geology; planetary geology; and the geology of Minnesota.

Geo 1005. GEOLOGIC PERSPECTIVES ON ENERGY. (4 cr; 4 lect hrs per wk) Day class and Extension class

Introduction to the geologic aspects of energy resources, conventional and unconventional. History of energy use, distribution and amounts of known and potential reserves, environmental aspects and implications of U.S. consumption patterns.

Geo 1012. PLANET EARTH. (4 cr) Day class

A nonmathematical introduction to planet Earth. Emphasis will be on the relationships between the various earth systems; the solid earth, hydrosphere and the atmosphere; and on various natural cycles that control the way the planet works naturally and how human interactions are perturbing the natural cycles and their rates.

Geo 1021. INTRODUCTION TO GEOLOGY LAB: GEOLOGY OF MINNESOTA. (1 cr; prereq 1001 or ¶1001 or #; one 2-hr lab) Day class and Extension class

Ten laboratory exercises based on the geology of Minnesota. These labs will introduce students to the bedrock, glacial history, topography, mineral resources, and environmental geology of the state through the use of appropriate minerals, rocks, topographic and geologic maps.

Geo 1111. INTRODUCTORY PHYSICAL GEOLOGY. (5 cr; prereq high school or college chemistry or #; 3 lect hrs, 1 rec hr, and two 2-hr labs per wk) Day class

For prospective majors and others desiring a more intensive course.

Geo 1601. OCEANOGRAPHY. (4 cr; 3 lect, 1 lab hrs per wk) Day class

How various processes in the ocean interact; analogies between the oceans and Lake Superior and smaller lakes in Minnesota. Topics include marine biology, waves, tides, chemical oceanography, marine geology and human interaction with the sea. Lab work includes study of live marine invertebrates and manipulation of oceanographic data.

Geo 3401. INTRODUCTORY MINERALOGY. (5 cr; 5004, 5404; prereq 1001 or 1111 or #, 1 term college chemistry, Math 1221; 3 lect and 6 lab hrs per wk) Day class

Crystallography, crystal chemistry, and crystal physics. Physical and chemical properties, crystal structures, and chemical equilibria of the major mineral groups. Laboratory includes crystallographic, polarizing microscope, X-ray powder diffraction exercises, and hand specimen mineral identification.

Geo 5004. MINERALOGY. (4 cr; 3401; not open to geology, geophysics, and geological or mineral engineering majors; prereq Math 1221, 1 term college chemistry, and #; 3 lect and 6 lab hrs per wk; offered when demand warrants) Day class

For description, see Geo 3401.

Geo 5108. ADVANCED ENVIRONMENTAL GEOLOGY. (4 cr; prereq geology core courses 1111 through 5201 or equiv or #) Day class and Extension class

Human impact on the geological environment and the effect of geology; geologic processes on human life from the point of view of ecosystems and biogeochemical cycles. Geologic limits to resources and carrying capacity of the earth. Land use planning, environmental impact assessment, ecogeologic world models. Field project.

Geo 5201. STRUCTURAL GEOLOGY. (5 cr; prereq 3401; 3102; IT: upper division major in Geo, Geophys, GeoE, MinE; CLA: jr or sr GEO major; or #) Day class

Primary and secondary structures of rocks, mechanics and modes of deformation, introduction to field methods in geology. Field trips.

Geo 5251. GEOMORPHOLOGY. (4 cr [5 cr with term project]; prereq 1001, Math 1111 or #; 3 lect, 2 lab hrs per wk; lab often used for field trips; offered when demand warrants) Day class

Study of the origin, development, and continuing evolution of landforms in various environments. Environmental implications are emphasized. Topics include weathering, slope and shore processes, fluvial erosion and deposition, wind action, tectonics, and impact phenomena.

Geo 5261. GLACIAL GEOLOGY. (4 cr [5 cr with term paper or map lab]; prereq 1002 or 3112; offered when demand warrants) Day class

Formation and characteristics of modern glaciers; erosional and depositional features of Pleistocene glaciers; history of Quaternary environmental changes in glaciated and nonglaciated areas. Field trips.

Geo 5311. GENERAL GEOCHEMISTRY. (4 cr; prereq 2 qtrs college chemistry or #) Day class

✿ **new** This course will develop principles pertaining to the distribution and control (structural, thermodynamic and kinetic) of chemical species in the earth and hydrosphere.

Geo 5313. AQUEOUS GEOCHEMISTRY. (4 cr; prereq 5311, Chem 5520 or #) Day class

✿ **new** Course emphasizes general principles of solution chemistry and with application to geology. These include solution-mineral equilibria, redox processes in natural waters, and the geochemistry of hydrothermal fluids.

Geo 5601. LIMNOLOGY. (4 cr; EBB 5601; prereq Chem 1005 or equiv) Day class

Description and analysis of events occurring in lakes, reservoirs, and ponds, beginning with their origins and progressing through study of their physics, chemistry, and biology. Emphasis on interrelationships of these parameters and on effects of civilization on lakes.

Geo 5611. GROUNDWATER GEOLOGY. (4 cr; prereq 1001 or 1111, Math 1231, 1 qtr physics and chemistry or #) Day class

Origin, occurrence, and movement of groundwater viewed in the context of the hydrologic cycle. Characteristics of aquifer systems. Exploratory investigations. Hydrogeologic units and boundaries of regional systems. Analysis of surface water groundwater interaction, recharge. Quality and chemistry of groundwater supplies. Contaminant hydrology.

Geo 8262. QUATERNARY PALEOECOLOGY AND CLIMATE. (4 cr; prereq 5261 or #; offered when demand warrants) Day class

Principles of stratigraphic pollen analysis. Pleistocene and Holocene vegetation and climatic history as interpreted from pollen diagrams from different parts of the world. Paleoclimatic interpretation of ocean-sediment cores.

Geo 8602. ADVANCED LIMNOLOGY. (3 cr; prereq 5601 or equiv, #) Day class

Detailed study of selected problems in limnology using current and classical literature. Term paper required.

Geo 8612. ANALYTICAL GEOHYDROLOGY. (3 cr; [4 cr with term paper]; prereq Math 3221, CE 3400 or #; offered when demand warrants) Day class

Microphysics of flow through porous media; geological factors in aquifer performance; equations for groundwater flow; analysis of pumping tests; potential theory in groundwater flow; computer and analog models of aquifers; groundwater basin analysis; contaminant fate and transport through aquifers.

Geo 8617. TRANSPORT PHENOMENA IN NATURAL POROUS MEDIA. (2 or 3 cr; prereq CE 3400 or Chem 5520 or equiv or #; 2 lect hrs per wk and term project ar; offered when demand warrants) Day class

Microscopic flow parameters, momentum, mass and energy transport through porous media, rate processes, coupled processes and nonequilibrium thermodynamics, geologic controls of natural flow systems in porous media and aquifers.

HISTORY OF SCIENCE AND TECHNOLOGY (HSci)

Babbage Institute for History of Information Processing

103 Walter Library, 624-5050
Arthur Norberg, 103 Walter Library, 624-5050

HSci 3331/5331. TECHNOLOGY IN AMERICAN CULTURE. (4 cr) Day class

Technology in America with emphasis on its impact on society and culture. Traces the growth of American technology in its cultural and intellectual context from colonial period to present.

HONORS COLLOQUIA (HCol)

Honors Program, College of Liberal Arts

115 Johnston Hall, 624-5522
Julia Corbett, 111 Murphy Hall, 625-9824

HCol 1010. HONORS COLLOQUIUM. FROM VCRs TO PCBs: COMMUNICATING ABOUT SCIENCE. (2 cr; prereq fr or soph, honors division regis) Day class

✿ **new** Every day, our activities are filled with "science"—when we zap food in the microwave, pop a tape in the VCR, or watch news reports about ozone holes and cancer research. But according to Carl Sagan, we are a nation of scientific illiterates with little understanding of the science that pervades our world.

This course will explore how our society communicates about this pervasive science, especially the role of scientists and the media in helping the public understand scientific technology and evaluate science policy. This course has practical relevance for students pursuing both scientific and literary fields. Topics for discussion include good and not-so-good science writing, scientists' responsibilities, PR and science, media messages about science, and humanizing science through literary writing.

HOUSING (Hsg)

College of Ecology

240 McNeal Hall, 624-9700
Evelyn Franklin, 240 McNeal Hall, 624-2290

Hsg 1401. RESIDENTIAL TECHNOLOGY. (4 cr, § 1801; prereq soph or #; Phys 1001 or 1041) Day class

✿ **new** Survey of equipment and technological systems in a residential environment. Emphasis on consumption and conservation of natural resources and energy sources and human considerations in kitchen planning and appliance design. Lecture, discussion, and laboratory.

Hsg 3463. ENVIRONMENT: HOUSING AND COMMUNITY. (4 cr, § 3863; prereq 1400 or 1851 or #) Day class

✿ **new** Housing process from development to occupancy, the many factors involved. Emphasis on design of physical environment and relationship of housing to neighborhood, community, city, and metropolitan area.

Hsg 5482. THE FAMILY AND ENERGY ISSUES. (3 cr, § 5801; prereq 1400 or 1851, 1401 or 1801 or #; offered 1992-93 and alt yrs) Day class

✿ **new** Analysis of family behavior as it relates to energy use, impact of scarce resources on quality of family functioning, family/energy issues in future.

HUMANITIES (Hum)

College of Liberal Arts

314 Ford Hall, 624-5553
W. John Archer, 358 Ford Hall, 624-3830

Hum 3366. LANDSCAPE AND IDEOLOGY, 1600-1875. (4 cr; Hum 3663) Day class

The cultural construction of "nature" as concept and as environment. From Puritan "garden in the wilderness" to 18th-century "natural" landscape garden and 19th-century transcendentalism. Attention to the role of agriculture, religion, philosophy, aesthetics, property relations, travel, and exploration.

INTERDEPARTMENTAL STUDY (ID)

College of Liberal Arts

225 Johnston Hall, 624-5701
Mary Lymer, 225 Johnston Hall, 624-5701

ID 3970. DIRECTED STUDIES. (3-15 cr per qtr; prereq OSLO [Office for Special Learning Opportunities] approval, Δ) Day class

Individual readings and research on topics that cross departmental lines.

ID 5525-5526. GARBAGE, GOVERNMENT, AND THE GLOBE. (4 cr winter, 4 cr spring) Extension class. *Different topics covered each quarter. Students may register for one or two quarters. Call (612) 625-3898 for information as to when specific topics will be offered, and for availability of graduate credit.*

A rigorous analysis of how garbage—yours, mine, ours—affects not only our economy, politics, environment, and health but also the lives of untold future generations of humans and other species. The problem of garbage does not lend itself to narrow disciplinary approaches, but calls for cooperation among many fields. Reflecting this need for boundary crossing, this course offers an interdisciplinary approach to learning about messy, real-world problems. Faculty from the Institute of Technology, the Carlson School of Management, and the Colleges of Agriculture, Biological Sciences, and Liberal Arts join students in examining topics such as the movement of toxic materials through the environment; the management of solid wastes, especially those generated by incinerators, power plants, municipal water treatment plants, etc.; the philosophic grounding of environmental exploitation in the ethics of humanism; the physical, chemical, and biological aspects of soils in environmental planning and conservation decisions; and the effect of environmental problems on economic competitiveness and domestic and international corporate operations. The courses will include lectures, exams, projects, films, and visiting speakers.

JOURNALISM AND MASS COMMUNICATION (Jour)

College of Liberal Arts

111 Murphy Hall, 625-9824
Julia Corbett, 111 Murphy Hall, 625-9824

Jour 5133. INTERPRETIVE REPORTING ABOUT SCIENCE. (4 cr; prereq 3101 or #, Δ; offered 1992-93) Day class

Role of journalistic communication in science; scientist-journalist relationships; communicating results of scientific investigations to public, specialized audiences, industry.

LANDSCAPE ARCHITECTURE (LA)

College of Architecture and Landscape Architecture

212 North Hall, 625-8285
Joan Nassauer, 212 North Hall, 625-8285

LA 1021. HISTORY OF ENVIRONMENTAL DEVELOPMENT: ARCHITECTURE. (4 cr; Arch 1021; 4 lect hrs per wk) Day class and Extension class

Introduction to the philosophy and principles of architecture and landscape architecture as an art; survey of environmental history from the ancient periods through the medieval age.

LA 1022. HISTORY OF ENVIRONMENTAL DEVELOPMENT: LANDSCAPE ARCHITECTURE. (4 cr; Arch 1022; prereq 1021; 4 lect hrs per wk) Day class and Extension class

Continuation of 1021 from the Renaissance through the modern eras; focuses on forces and individuals that shaped the form of architecture and landscape architecture in the 19th and 20th centuries in America and Europe.

LA 1023. HISTORY OF ENVIRONMENTAL DEVELOPMENT: PLANNING. (4 cr; Arch 1023; prereq 1022; 4 lect hrs per wk) Day class and Extension class

Introduction to urban planning. Survey of the rise and history of cities as centers of civilization. Collaboration among various disciplines for creating better urban environment and improving the quality of human life in cities.

LA 1031. INTRODUCTION TO LANDSCAPE ARCHITECTURE. (4 cr; 4 lect hrs per wk) Joint Day/Extension class

Design potential of materials of the landscape; exercises in assessment of land developments and detail landscapes; the role of landscape architecture in shaping the natural and cultural environment; brief historical review of site developments.

LA 3001. ENVIRONMENTAL DESIGN: PEOPLE AND ENVIRONMENT. (4 cr; Arch 3001) Day class

Interaction of people with the environment, using natural and social sciences and the arts as background for readings, lectures, discussions, and workshop sessions.

LA 3002. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES. (4 cr; Arch 3002; prereq 3001) Day class

Nature and the effects of various tools and processes of environmental change, ranging from buildings and landscapes to economic policies, climate, and myths. Readings, lectures, discussions, and workshop sessions.

LA 5105. RECREATIONAL PLANNING AND DESIGN. (6 cr; prereq 5010; 2 lect and 12 lab hrs per wk) Day class

Analysis, development, and presentation of landscape design solutions for diverse, recreational land uses.

LA 5107. REGIONAL LANDSCAPE DESIGN. (6 cr; prereq senior or grad or #) Day class

Emphasis on large-scale land areas. Analyzing development potential and evolving solutions for integration of such divergent land use patterns as agricultural, residential, commercial, industrial and recreational.

LA 5119. PLANTING DESIGN: ECOLOGICAL PRINCIPLES/ LAND USE CONCEPTS AND IMPLEMENTATION. (4 cr; prereq 3092 or #) Day class; summer session Extension class

Lectures, presentations, field trips, readings, and projects related to principles and practices of using plant materials in an ecologically sound and environmentally sensitive manner. Principles derived from prairie, north woods, riverine, and wetland environments. Integrating naturalized materials in environnments of various scales. Historic and modern land use planting concepts. Planting implementation skills.

LA 5562. INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS. (4 cr; prereq jr, sr, or grad major in Geog or LA or #) Day class

Basic concepts of geographic information systems structure. Theory and applications for landscape location and resource analysis, and regional planning. Location principles, data structure, and variable attributes.

LA 8330. CONCEPTS OF LANDSCAPE EVALUATION. (3 cr; prereq 8108, MLA student or #) Day class

Studies in philosophical bases for and wide-ranging approaches to evaluating qualitative aspects of landscape. Emphasis on aesthetic factors.

LA 8390. DESIGNING THE LONG-TERM LANDSCAPE. (2 cr; prereq MLA student or #) Day class

Problems of designing landscapes that must sustain their integrity over generations or centuries. Survey of historical examples. Design theory, principles, and strategies.

LAW SCHOOL (Law)

285 Law Building, 625-1000
Daniel Farber, 350 Law, 625-1022

Law 5215. ENVIRONMENTAL LAW. (3 cr) Day class

Legal aspects of major environmental problems with emphasis upon pervasive issues that reappear in various regulatory contexts: e.g., the degree to which environmental quality should be protected; who should bear the cost enhancing environmental quality; the allocation of responsibilities among courts, legislatures, and administrative agencies; the role of citizens' groups and environmental litigation.

Law 5885. ADVANCED ENVIRONMENTAL LAW. (2 cr; Law 5215) Day class

This seminar will provide in-depth coverage of current issues in environmental law, with visiting lectures by environmental law specialists. Among the topics covered will be hazardous waste disposal, water pollution, and toxic torts. Student papers will analyze current controversial issues in environmental law. Satisfies senior writing requirement.

MECHANICAL ENGINEERING (ME)

Institute of Technology

125 Mechanical Engineering, 625-0705
B.Y. Liu, 130 Mechanical Engineering, 625-6574

ME 5603. THERMAL ENVIRONMENTAL ENGINEERING. (4 cr; prereq 3303, 5342 or equiv, IT student or grad; 4 lect hrs per wk; offered 1992-93 and alt yrs) Joint Day/Extension class

Thermodynamic properties of moist air; psychometric chart applications; solar radiation; heat and moisture transmission through structures; human thermal comfort and indoor air quality; heating, cooling, ventilation systems and controls.

ME 5609. AIR POLLUTION. (4 cr; prereq 3303 or #, IT student or grad; 4 lect hrs per wk) Joint Day/Extension class: refer to daytime *Class Schedule*

Air pollution sources, atmospheric transport, transformations and fate. Air pollution meteorology, dispersion, and models. Basic chemistry of secondary pollutant formation, aerosol growth, air pollutant visibility relationships. Standards and regulations.

ME 5610. AIR POLLUTION CONTROL. (4 cr; prereq IT or grad student, 3303) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Study of control devices and techniques for gases and particulate emissions from stationary and mobile sources. Topics include cyclones, electrostatic precipitators, bag houses, wet and dry scrubbers, combustion modification, and alternate fuels.

ME 5630. THERMAL ENVIRONMENTAL ENGINEERING SENIOR LABORATORY. (2 cr; prereq 3701, 3702, 5603 or ¶5603; ME upper division) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** Experiments in psychrometrics, refrigeration, air conditioning, solar energy, and other topics related to refrigeration and building heating and cooling.

ME 5712. SOLAR ENERGY UTILIZATION. (4 cr; prereq 5342 or #, IT student or grad; 4 lect hrs per wk; offered when feasible) Joint Day/Extension class

History and potential of solar energy utilization; availability of solar radiation on clear and cloudy days; incident radiation on horizontal, vertical, and inclined surfaces; flat-plate and concentrating solar collectors; heating and cooling with solar energy; power generation; review of current research.

MICROBIOLOGY (MicB)

College of Biological Sciences, College of Liberal Arts, and Medical School

1460 Mayo Memorial Building, 624-6190
Palmer Rogers, 925 Mayo Memorial Building, 624-7140

MicB 3103. GENERAL MICROBIOLOGY. (5 cr; 5105, Biol 5013, VPB 3103; prereq soph with C avg in courses prereq to major sequence, or jr with 10 cr chemistry and 5 cr biological sciences or #; offered 1992-93) Extension class

Morphology, physiology, taxonomy, and ecology of bacteria. Applications of fundamental principles. Lab.

MicB 5352. APPLIED MICROBIOLOGY. (4 cr; prereq 5321 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

Microbial adaptation to various environments; role of microorganisms in the earth's biogeochemical cycles. Application of microbial systems to industrial processes; basic principles of fermentation technology; microbial bioconversions and product formation. Biodegradation of chemicals.

MicB 5611. MICROBIAL ECOLOGY. (3 cr; prereq 3103 or 5105 of Biol 5013 or Soil 5610 or #; Soil 5605) Joint Day/Extension class: refer to daytime *Class Schedule*

Interrelationship of microorganisms with terrestrial, aquatic and organismal environments; survey of bacterial, fungal and algal components of ecosystems; evolution and structure of microbial communities; population interactions within ecosystems; quantitative and habitat ecology; biogeochemical cycling; and biotechnological approaches to the study of microbial ecology.

NATURAL RESOURCES AND ENVIRONMENTAL STUDIES (NRES)

College of Natural Resources and College of Agriculture

John V. Bell, 135 Natural Resources Building, 624-6768;
Terrence H. Cooper, 439 Borlaug Hall, 625-7747

NRES 1001. ORIENTATION TO NATURAL RESOURCES AND ENVIRONMENTAL STUDIES. (1 cr; S-N only) Day class

Information about NRES major. Discussions with faculty adviser. Employment information. Current topics in NRES. Information about facilities. Discussions with alumni.

NRES 1010. ISSUES IN THE ENVIRONMENT. (3 cr) Day class

Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design providing maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving twenty taped lectures and ten discussion periods.

NRES 1040. NATURAL RESOURCES AS RAW MATERIALS. (2 cr) Day class

Role of natural resources as raw materials for industry and economic development. Environmental and economic trade-offs associated with raw material gathering, processing, and use. Implications of processing technologies, energy consideration.

NRES 3001. COLLOQUIUM IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES. (1 cr) Day class

Round table discussions of current topics in Natural Resources and Environmental Studies.

NRES 3050. EXPERIENCE AND TRAINING IN A FIELD SETTING. (1-4 cr; prereq jr or sr standing) Day class

Students are required to obtain professional experience in a field setting by attending field sessions, completing a Professional Experience Program, or volunteering for various natural resource and/or environmental programs through local, state or federal agencies. Approval by an instructor required.

NRES 3060/5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT. (3 cr; 3060, 5060) Day class

Water quality issues and concerns in the broader context of natural resource management. Global and ecological perspectives toward understanding the management of surface and groundwater resources.

NRES 3225. NRES DIRECTED STUDY EXPERIENCE. (1-5 cr ar, prereq fresh or soph) Day class

Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the advisor for the project, a prospectus and completes progress reports and a final report on his or her project.

NRES 5100. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES. (5 cr; prereq sr standing) Day class

Development of a solution to a real-world natural resource and/or environmental problem. Discussions and assignments reflect diverse aspects of the problem. Oral and written presentations. Students participate as members of a team.

NRES 5210. SURVEY, MEASUREMENT, AND MODELLING METHODS FOR NATURAL RESOURCES I. (3 cr; prereq Math 1142, Stat 3011 and computer competency) Day class

Introduction to survey design, measurement concepts, and modelling methods useful in the study of natural resources and environmental issues. Emphasis on data collection and analysis.

NRES 5220. SURVEY MEASUREMENT AND MODELLING METHODS FOR NATURAL RESOURCES II. (4 cr; prereq 5212 or NRES 5210 or equiv and computer programming) Joint Day/Extension class: refer to daytime *Class Schedule*

Advanced survey design, measurement concepts, and modelling methods for study of natural resources and environmental problems.

NRES 5225. NRES DIRECTED STUDY EXPERIENCE. (1-5 cr ar; prereq jr, sr, or grad) Day class

Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the advisor for the project, a prospectus and completes progress reports and final report on his/her project.

NRES 5600. PRINCIPLES OF WASTE MANAGEMENT. (4 cr; prereq Soil 1020 or 3125, and 1 course in chemistry and in biology) Day class

Understanding the issues, problems and solutions in remediating the waste stream generated by today's society. Topics include waste stream dynamics, municipal solid waste and yard waste composting, waste to energy incineration operaton, ash disposal, recycling, landfill requirements, and requirements for direct land disposal, regulatory trends, and case studies.

PHYSICS (Phys)

Institute of Technology

148 Physics, 624-7375; K. Mauersberger, 42 Physics, 624-6305

Phys 5461. PHYSICS AND CHEMISTRY OF THE EARTH'S UPPER ATMOSPHERE. (4 cr; prereq general physics and calculus; offered when feasible) Day class

Survey of atmosphere above 15 km; physics and chemistry of the stratosphere, mesosphere, and thermosphere; temperature and density profiles; major and minor constituents and their distributions; aspects of pollutants; reactions and rates; global variation of constituents; the energy budget of the atmosphere.

PLANT BIOLOGY (PBio)

College of Biological Sciences

220 Biological Sciences Center, 625-1234
Thomas Soulen, 220 Biological Sciences, 625-1234

PBio 1009. MINNESOTA PLANT LIFE. (4 cr; suitable for non-majors) Joint Day/Extension class: refer to daytime *Class Schedule*

Identification of the more characteristic and conspicuous Minnesota plants, including many lower forms, with discussion of their basic distinctions, life cycles, habitat requirements, distribution, vegetation types, and ecological relations. Lectures, demonstrations, six field trips.

PBio 1012. PLANTS USEFUL TO HUMANS. (4 cr; for majors or nonmajors) Day class and Extension class

Roles that plants play and have played in human biological and cultural development. Lectures and demonstrations.

PBio 3201. INTRODUCTORY PLANT SYSTEMATICS. (4 cr; prereq Biol 1103 or 3012) Day class

Systematics of the flowering plants of the world. The ecology, geography, origins, and evolution of the flowering plants; family characteristics; floral structure, function and evolution; pollination biology; methods of phylogenetic reconstruction; molecular evolution; taxonomic terms; methods of collection and identification. Two field trips.

PBio 5103. ALGAE, FUNGI, AND BRYOPHYTES. (5 cr; prereq Biol 1103 or 3012; offered when feasible) Day class

Characteristics of groups, evolutionary relationships, life cycles, comparative morphology (including ultrastructure), comparative nutrition. Laboratory emphasizes living material and isolation of algae and fungi into culture.

PBio 5183. WATER, MINERALS, AND TRANSLOCATION. (4 cr; § PlPh 5183; prereq 5131 or equiv) Day class

Membrane phenomena and osmotic properties of cells. Uptake, movement, and loss of water in plants; effects of external factors. Translocation of organic substances. Absorption, distribution, and function of inorganic elements.

PBio 5231. INTRODUCTION TO THE ALGAE. (5 cr; prereq 10 cr in plant biology or biology or #; offered when feasible) Day class

Structure, reproduction, and life histories of major algal divisions.

PBio 5801. PLAINS AND BOREAL FLORA. (5 cr; limited to 20 students; prereq course in taxonomy; Δ; given at Itasca) Day class

✿ **new** Survey of the summer flowering plants and ferns of the state with particular reference to the local flora. Identification by technical keys; important plant families; field recognition of common species; habitat preferences; natural history and population biology of selected important species.

PBio 5811. FRESHWATER ALGAE. 5 cr; prereq 10 cr plant biology, biology or zoology or equiv; Δ; given at Itasca) Day class

✿ **new** Morphology, systematics, and distribution of the local algal flora. Collection, preservation, numeration, and culture techniques; identification of field collections using appropriate technical literature. Ecological implications of species interactions, algal association, and indicator taxa.

PLANT PATHOLOGY (PlPa)

College of Agriculture

495 Borlaug Hall, 625-8200
Philip Larsen, 495 Borlaug Hall, 625-8200

PlPa 5002. INTRODUCTORY PLANT PATHOLOGY. (5 cr; prereq 14 cr plant sciences or #) Day class

Introductory course in plant diseases. Lectures, laboratory and special problems.

PlPa 5007. AIR POLLUTANTS AND THEIR EFFECTS ON PLANTS. (3 cr; prereq 20 cr biology incl biochemistry) Day class

Sources, types, and forms of air pollution; air pollution and changing climate; impacts of air pollution on crops and forests; acidic rain; methods of studying air pollution effects on plants including diagnosis; air quality regulations and policies.

PlPa 5050. FOREST PATHOLOGY. (4 cr; prereq 10 cr plant sciences or forestry) Day class

Diseases of forest and shade trees; wood decay. Symptoms, etiology and control. Lectures, laboratory, and field work.

PlPa 5102. ECOLOGY OF FUNGI. (3 cr; prereq 5 cr botany; offered 1992-93 and alt yrs) Day class

Emphasis on ecological studies and identification of fungi. Lectures include topics on fungal symbioses, morphology, coevolution and applicable ecological theory. Student teams will determine species richness in an aquatic, grassland, and forest habitat.

PlPa 5105. INTRODUCTION TO THE STUDY OF FUNGI. (4 cr; prereq 9 cr botany or Biol 1002 or #) Day class

Structure, habits, classification, and identification of fungi.

PlPa 5106. MYCOLOGY: ASCOMYCETES—FUNGI IMPERFECTI. (4 cr; prereq 5105 or equiv or MicB 3103 or #; offered alt yrs) Day class

Lectures and laboratory exercises in taxonomy, identification, life histories, genetics, and ecology of fungi.

PlPa 5107. MYCOLOGY: BASIDIOMYCETES. (4 cr; prereq 5105 or equiv or MicB 3103 or #; offered alt yrs) Day class

Lectures and laboratory exercises in taxonomy, identification, life histories, genetics, and ecology of fungi.

PlPa 8003. PLANT DISEASE THEORY III, POPULATIONS. (4 cr; prereq 5005, 5006, 5007 or #, and 8001, 8002) Day class

Disease in populations of plants; agroecosystems, natural ecosystems, and interrelatedness of plant disease over large geographic areas. This course introduces elements of population genetics, epidemiology, and geopathology.

PlPa 8111. FUNGAL GENETICS. (4 cr; prereq Genetics 3022) Day class

Attributes of the genetics of fungi using classical approaches, including mendelian and quantitative traits, ecological and population genetics, incompatibility systems, tetrad analysis, treterokaryosis, somatic recombination, plasmids, genetics of parasitism, and moecular genetics techniques.

POLITICAL SCIENCE (Pol)

College of Liberal Arts

1414 Social Sciences, 624-4144
Martin Sampson, 1414 Social Sciences, 624-4144

Pol 3872. INTERNATIONAL ORGANIZATIONS AND THE ENVIRONMENT. (4 cr; prereq pol sci or int rel maj or 12 cr in soc sci or #) Day class

✿ **new** Provide opportunity for students to learn about international organization as an aspect of international relations; "learn" means awareness of basic characteristics of such groups and also awareness of disputes in the literature about the significance of international organizations.

Pol 5523. THE POLITICS OF THE REGULATORY PROCESS. (4 cr; prereq 1001 or equiv or #; offered when feasible) Day class

Operations of regulatory agencies considered in context of political and legal environment. Principles of federal administrative law, informal procedures, interest group activity, philosophy of regulation, politics and processes of deregulation.

PUBLIC AFFAIRS (PA)

Hubert H. Humphrey Institute of Public Affairs

300 Humphrey Center, 625-9505
D.E. Abrahamson, 243 Humphrey Center, 625-2338

PA 5601. LAND USE. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Physical, spatial basis for community and regional development. Private sector development processes. Public regulatory frameworks, guidance and interventional strategies. Integration of physical, social and economic factors in land use policy, planning and decision-making. Graduate status or written permission.

PA 5622. MANAGING URBAN GROWTH AND CHANGE. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Integrated systems of controls and incentives to manage land development at state, metropolitan, and local government levels. Traditional planning and land use devices, tax and fee techniques, environmental regulations and innovative controls.

PA 5701. TECHNOLOGY PLANNING I. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Relationship of science and technology to ideological bases of our society; identification of technology's significance to the policy process; analysis of our society's institutions for governing its technologies.

PA 5711. ENERGY POLICY I. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Possible energy supply systems and ways energy is consumed; relatively non-technical description of physical systems, environmental and social impacts, regulatory frameworks, resource base, and relationship to energy policy options.

PA 5712. ENERGY POLICY II. (3 cr; offered 1993-94) Joint Day/Extension class: refer to daytime *Class Schedule*

Energy policy options including political, economic, environmental, and other considerations.

PA 5721. ENVIRONMENTAL POLICY I. (3 cr; offered 1993-94) Joint Day/Extension class: refer to daytime *Class Schedule*

Systems in the natural and physical environment. Environmental impacts of technological innovation. Associated social controversy. Legislative, judicial, regulatory responses.

PA 5722. ENVIRONMENTAL POLICY II. (3 cr; offered 1992-93) Joint Day/Extension class: refer to daytime *Class Schedule*

Relationship of science and technology to ideological bases of our society; identification of technology's bases of our society, identification of technology's significance to the policy process analysis of our society's institutions for governing its technologies.

PA 5791. SCIENCE, TECHNOLOGY AND INTERNATIONAL AFFAIRS. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Ways in which science and technology in the closing decades of the 20th century directly affect the global economic, political, and social environment. How the dynamics of technological development and specific advances in science and technology affect relations among nations in such matters as autonomy, national security, distribution of power, cultural identity and international cooperation. Various approaches to determining national policy and negotiating international agreements in areas affected by science and technology.

PA 5792. TOPICS IN ENVIRONMENT AND ENERGY POLICY. (3 cr) Day class

Description not yet available. For information, contact Karen Schuster, 154 Humphrey Center, 625-3497.

PA 5794. ECONOMICS OF NATURAL RESOURCE POLICY. (4 cr; prereq Econ 3101 or #) Joint Day/Extension class: refer to daytime *Class Schedule*

✿ **new** (Same as AgEc 5650) Application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.

PA 8691-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN LAND USE AND HUMAN SETTLEMENTS. (3 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Advanced analysis of selected topics in land use and human settlements such as large scale planned communities, agricultural preservation, historical preservation, infrastructure planning and programming, urban transportation policy.

PA 8791-99. WORKSHOP/SEMINAR: ADVANCED TOPICS IN TECHNOLOGY, ENERGY, AND ENVIRONMENTAL POLICY. (3 cr; offered 1992-93) Joint Day/Extension class: refer to daytime *Class Schedule*

Topics in technology, energy, and environment, such as hazardous waste, energy efficiency, nuclear technologies, or atmospheric carbon dioxide.

RECREATION, PARK, AND LEISURE STUDIES (Rec)

College of Education

203 Cooke Hall, 625-5300
Leo H. McAvoy, 203 Cooke Hall, 625-5887

Rec 5250. FINANCING LEISURE SERVICES. (3 cr; prereq 3550 or Δ) Day class

Methods and techniques of financing operations and capital improvements in public park and recreation agencies and nonpublic community leisure services; sources of revenue budgeting procedures.

Rec 5300. FOUNDATIONS OF OUTDOOR EDUCATION. (3 cr; prereq sr, 1520 or 5100 or #) Day class

Investigation of the philosophical, historical, and educational foundations of outdoor education.

Rec 5310. PROGRAMMING IN OUTDOOR EDUCATION. (4 cr; prereq 5300 or #) Joint Day/Extension class limited to 10 Extension students

Methods, materials and settings for outdoor education and environmental interpretation programs.

Rec 5350. WILDERNESS OUTDOOR RECREATION PROGRAMMING. (4 cr; prereq 3150 or #) Day class

Exploration of leisure and educational resources of wilderness and management of wilderness-based outdoor recreation and outdoor education programs.

RHETORIC (Rhet)

College of Agriculture

202 Haecker Hall, 624-3445
Thomas Scanlon, 202 Haecker Hall, 624-1262

Rhet 1310. HUMANITIES: THE LAND IN AMERICAN EXPERIENCE. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

American attitudes toward the land from colonial times to the present as expressed in social history, literature, and fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of America.

Rhet 3375. HUMANITIES: AGRICULTURAL HERITAGE. (4 cr) Joint Day/Extension class: refer to daytime *Class Schedule*

Examination and analysis of significant events or periods affecting rural agriculture peoples as expressed in historical, cultural, and literary documents. Understanding of major values, attitudes, and philosophies related to agricultural change and development.

SMALL ANIMAL CLINICAL SCIENCES (SACS)

College of Veterinary Medicine

Patrick T. Redig, Gabbert Raptor Center, 624-4969

SACS 5330. WILD BIRD MEDICINE. (2 cr; prereq regis vet med, 3rd or 4th year or DVM grad student or #) Day class

Overview of important aspects of clinical avian anatomy and physiology and pathology. Survey of diseases common to wild birds and medical/surgical management of common injuries and fractures.

SOCIOLOGY (Soc)

College of Liberal Arts

909 Social Sciences, 624-4300
Robert Kennedy, 1125 Social Sciences, 624-1615

Soc 3551. WORLD POPULATION PROBLEMS. (4 cr) Day class

Population growth and natural resources, population dynamics, fertility and mortality in less developed and industrialized nations, population forecasts, policies to reduce fertility.

Soc 3960. ENVIRONMENTAL SOCIOLOGY. (4 cr) Day class

✿ **new** Societal causes of environmental pollution and degradation. Includes investigation of religion, economics, politics, social movements, social stratification by wealth, race and gender, world development and global response to the problem.

SOIL SCIENCE (Soil)

College of Agriculture

439 Borlaug Hall
Terrence H. Cooper, 439 Borlaug Hall, 625-7747

Soil 1020. THE SOIL RESOURCE. (5 cr; 3125) Fall: Extension class; Winter: Day class

Introduction to the physical, chemical, and biological aspects of soils. Use of the soil classification system to understand the use of soil survey information for land-use planning. Concepts of soil fertility for understanding plant growth requirements. Introduction to urban soils and their management. Understanding soil's role in environmental planning and conservation decisions.

Soil 1262. INTRODUCTION TO METEOROLOGY. (4 cr) Day class

(Same as Geog 1425) Pre-calculus introductions to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

Soil 1500. BIOTECHNOLOGY: BASIC CONCEPTS AND APPLICATION. (3 cr; prereq H.S. biol and H.S. chem or #) Day class

Introduction to biotechnology for students interested in this field as part of a liberal education, as well as those contemplating careers in the sciences. Genetic engineering, application of biotechnology to microbes, plants and animals, and legal and ethical issues are discussed.

Soil 3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY. (1 cr; [may be repeated for max 3 cr]; S-N only) Extension class

Speakers from the University, the public, and state and federal agencies address a current rural soil and water environmental issue, with emphasis on policies and pertinent technical concerns. A new topic is examined each time offered.

Soil 3125. BASIC SOIL SCIENCE. (5 cr; prereq Chem 1001 or 1004) Day class

Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures and laboratory.

Soil 3220. SOIL CONSERVATION AND LAND USE MANAGEMENT. (4 cr; prereq Soil 1020/3125 or #) Day class

Soil erosion and land degradation processes on rural and urban landscapes. Technical, historical, economic, social, and international considerations of soil conservation. Land-use management practices for soil conservation and methods of natural resource assessment. Lectures, field trips, and computer lab.

Soil 5210. SOIL PHYSICAL PROPERTIES AND THE ENVIRONMENT. (4 cr; prereq 1020 or 3125 or #) Day class

✿ **new** Physical characteristics of soil related to movement of water, solutes, and heat. Relationship of soil physical properties to water quality, plant water use, and growth. Lecture and laboratory.

Soil 5240. MICROCLIMATOLOGY (SOILS). (5 cr; prereq Math 1111, 10 cr physics or #) Day class

Meteorology and climatology in relation to the soil-atmosphere interface, with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate, description of meteorological instruments, and use of weather data.

Soil 5424. APPLIED CLIMATOLOGY. (3 cr; prereq 5140 or Geog 3421 or #) Day class

Intended for advanced undergraduates and beginning graduate students who have a background in the principles of climatology or microclimatology. Sources of climatic data, methods of analysis, and selected set of specific applications that focus on agricultural and environmental management problems.

Soil 5510. FIELD STUDY OF SOILS FOR ENVIRONMENTAL ASSESSMENT. (4 cr; prereq 1020 or 3125 or #) Day class

✿ **new** Field observation and identification of the morphological characteristics of soils. Interpretation of soil profiles for environmental assessment. Identification of soil landscapes and the influence of soil-forming factors on soil morphology. Lecture and field laboratory.

Soil 5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION. (3 cr; prereq 1122 or #) Day class

Formation, properties, and management of peatlands important to crop, forestry, and energy production in this state and worldwide. Lecture.

Soil 5560. INTERPRETATION OF LAND RESOURCES. (3 cr; prereq 3520 or #) Joint Day/Extension class

Techniques used in preparing soil maps of varying scales. Information available from soil maps and accompanying reports evaluated for use in agriculture, engineering, waste treatment, forestry, and land planning. How soil survey information can be used to the fullest extent in land resource interpretation.

Soil 5605. MICROBIAL ECOLOGY. (3 cr; prereq MicB 5105 or Biol 5013 or Soil 5610 or #; MicB 5611) Day class

Interrelationship of microorganisms with terrestrial, aquatic and organismal environments; survey of bacterial, fungal and algal components of ecosystems; evolution and structure of microbial communities; population interactions within ecosystems; quantitative and habitat ecology; biogeochemical cycling; and biotechnological approaches to the study of microbial ecology.

Soil 5610. SOIL BIOLOGY. (4 cr; prereq 1020/3125 and PlPa 1001 or #) Day class

The soil environment and its biological population. Role of living organisms in the soil-plant environment and cyclic transformations of agronomic interest (carbon, nitrogen, and mineral substances). Effect of soil microflora on soil fertility and plant nutrition. Lectures and laboratory.

UNIVERSITY COLLEGE (UC)

12 Morrill Hall, 624-2022
Susan Stonefield, 7 Wulling Hall, 624-2004

UC 3075. INDEPENDENT STUDY. (3-15 cr; prereq Δ) Day class and Extension class

UC 3075 is an undergraduate directed study registration available to students who wish to pursue learning projects that go beyond the scope of any single department or college of the University. Students must have a University of Minnesota faculty sponsor. Projects are either interdisciplinary in nature or are monitored by faculty from departments that do not have an appropriate undergraduate directed study registration. Students design their own learning projects, working closely with appropriate faculty who also supervise and evaluate the project. May be taken for 1 to 15 degree credits.

IV. CENTERS

JAMES FORD BELL MUSEUM OF NATURAL HISTORY

College of Biological Sciences
Ken Corbin, Interim Director, 10 Church Street S.E., University of Minnesota, Minneapolis, MN 55455; 624-4112

The museum features exhibits of Minnesota wildlife, the Touch and See Room, and the Jacques Gallery of natural history art. It also houses extensive research collections of birds, mammals, reptiles, amphibians, and fish. Public education programs on natural history are offered throughout the year. The Natural History Library, located in the museum, emphasizes collections in vertebrate zoology, behavior, and basic ecology.

CENTER FOR POPULATION ANALYSIS AND POLICY

G. Edward Schuh, Acting Director, 300 Humphrey Center, 301 19th Ave. S., University of Minnesota, Minneapolis, MN 55455; 625-9505

The Center for Population Analysis and Policy (CPOP) is an international interdisciplinary population research center founded in 1987. In addition to some fifty faculty members from a broad range of disciplines at the University of Minnesota, CPOP's research involves participants from across the United States and Europe, as well as the U.S.S.R. and China. Some of CPOP's current activities include offering weekly research seminars, sponsoring conferences, and developing a graduate program in population sciences.

CENTER FOR TRANSPORTATION STUDIES

Richard P. Braun, Director, 110 Civil and Mineral Engineering Building, 500 Pillsbury Drive S.E., Minneapolis, MN 55455; 626-1077

The Center for Transportation Studies was established in 1987 by the University's Institute of Technology. It serves as a focal point for strengthening knowledge in transportation through multidisciplinary approaches that address transportation problems. The Center identifies critical issues in transportation and develops research, education, and outreach programs that: 1) create an interactive environment for faculty, students, and practitioners from multiple disciplines to collaborate in transportation research and education efforts; and 2) provide leardership and outreach efforts to government officials, private sector representatives, and the public in the application of new knowledge and the implementation of policies, programs, and technology that improve transportation.

The Center's research program is categorized into four main emphases: transportation and the economy, transportation safety and traffic flow, the transportation infrastructure, and transportation and the environment. The last emphasis includes research in disciplines ranging from mechanical engineering to plant biology and urban planning. Topics include alternative fuels; vehicle emission measuring systems; alternative modes of transportation such as ligh-rail transit and bicycling; urban design concepts for improving the efficiency of transportation systems; the use of competitive species for long-term control of roadside weeds; and tolerance of native Minnesota grasses to road salt.

In education, the Center works to improve existing transportation education programs as well as to strengthen and broaden continuing education opportunities for professionals. A major initiative is the Institute on Advanced Transportation Systems, which the Center administers for the University. Through this continuing program, the University has received federal monies to develop four new courses as well as to fund several fellowships. The Center also supports the development of new faculty positions and promotes transportation careers to University students through seminars and other means.

Finally, in the outreach area the Center conducts a comprehensive program that includes an annual research conference, seminars, publications, and other means of communication. These efforts are designed to encourage interaction and technology transfer among faculty, students, and practitioners in support of the public service mission of the University.

CENTER FOR URBAN AND REGIONAL AFFAIRS (CURA)

Thomas M. Scott, Director, 330 Humphrey Center, 301 19th Ave. S., University of Minnesota, Minneapolis, MN 55455; 625-1551

The regents established the Center for Urban and Regional Affairs to help make the University more responsive to the needs of the larger community and to increase the constructive interaction between faculty and students, on the one hand, and between the University and those dealing directly with major public problems, on the other hand.

Specific projects of the center are selected from several broad problem areas reflecting major concerns in this region: economic development and employment, environment, housing, human services, land use management, planning and public affairs, and the diffusion of information about these topics. These problems cut across a wide and changing array of disciplines.

CURA's role is to help coordinate and stimulate projects in these problem areas. It works with the faculty and students of all academic units of the University. All CURA programs are pilot, experimental, or short term projects. The goal is to probe and evaluate, complete short-term projects, discard unsuccessful ones, and help build successful ones into the appropriate part of the academic structure. It confines itself to projects for which there is currently no other practical administrative home.

The center also publishes a newsletter, the *CURA Reporter*. Information about both the newsletter and the center may be obtained from the CURA office.

DEPARTMENT OF PROFESSIONAL DEVELOPMENT AND CONFERENCE SERVICES

Nolte Center for Continuing Education
David Grossman, Acting Director, 215 Nolte Center for Continuing Education, 315 Pillsbury Drive S.E., University of Minnesota, Minneapolis, MN 55455; 626-2255

The Department of Professional Development and Conference Services, with support from the University of Minnesota academic faculty, assists groups in developing and presenting noncredit continuing education programs.

The department has a professional staff to assist interested parties in planning, publicizing, administration, and evaluation of continuing education programs. PDCS occasionally sponsors programs for the general public in the fields of environment, urban problems, and planning. For further information contact the director.

GRAY FRESHWATER BIOLOGICAL INSTITUTE

College of Biological Sciences
Steven J. Eisenreich, Director, P.O. Box 100, County Roads 15 and 19, Navarre, MN 55392; 471-8476

The Gray Freshwater Biological Institute is a research facility where faculty and staff members, postdoctoral fellows, and students from several disciplines (microbiology, biochemistry, limnology, biogeochemistry, environmental chemistry) conduct basic and applied research dealing with problems of aquatic systems.

LAKE ITASCA FORESTRY AND BIOLOGICAL STATION

College of Biological Sciences
Administrative Office: Donald B. Siniff, Director, 305 Zoology, 318 Church Street S.E., Minneapolis, MN 55455; 625-9165

Located at the headwaters of the Mississippi River in northern Minnesota, the field station is an ecological area where three plant regions of the United States meet. Fifty square miles of protected forest provide unique opportunities for study of varied ecosystems and of the fauna and flora with southern, northern, and western origins. Diverse lakes and wetlands provide unusual field advantages for aquatic studies. For a list of courses held at the Station, see the entry for Lake Itasca in Part I, "Courses Listed by Subject Area."

LIMNOLOGICAL RESEARCH CENTER

Newton Horace Winchell School of Earth Sciences
Institute of Technology
Kerry Kelts, Director, 220 Pillsbury Hall, 310 Pillsbury Drive S.E.,
University of Minnesota, Minneapolis, MN 55455; 624-7005

This center conducts research on lakes from four perspectives: a) lakes as archives of changing environment and climate, b) lakes as models of biological, ecological, physical and biogeochemical processess, c) lakes as geological features in Earth history, d) lakes an natural resources. Studies of lake history are made through analyses of microfossils, sediment components, and geochemical signatures. Research activities are global in scope.

Evening seminars for current problems are held in Fall for limnology, and Spring for paleoenvironment. Courses and degree programs are coordinated through the Department of Geology and the Department of Ecology, Evolution, and Behavior, and a Quatenary Paleoecology minor. The center participates in a Research Training Group for paleorecords of global change.

MINNESOTA BUILDING RESEARCH CENTER

College of Architecture and Landscape Architecture
Institute of Technology
Institute of Agriculture, Forestry, and Human Ecology
David T. Grimsrud, Director, 330 Wulling Hall, 86 Pleasant Street SE,
Minneapolis, MN 55455; 626-7419

The Minnesota Building Research Center (MnBRC) is a network of researchers from a range of disciplines (architecture, landscape architecture, civil and mineral engineering, mechanical engineering, forest products, design, housing, and apparel, agricultural engineering, and extension service) who are concerned with solving problems associated with the design, construction and operation of energy efficient, cost effective buildings in cold climates. MnBRC provides both a focus for the development of interdisciplinary research concerning these issues and a common source of information germane to cold climate buildings and their environments.

MINNESOTA GEOLOGICAL SURVEY

Newton Horace Winchell School of Earth Sciences
Institute of Technology
Priscilla Grew, Director, 2642 University Avenue, St. Paul, MN 55114;
627-4780

The Minnesota Geological Survey is engaged in a number of activities related to the environment and planning. These include developing a database of waterwell logs and groundwater data for the state of Minnesota and preparing county atlases containing geological, hydrogeological, and resource information useful for environmental planning and management.

Undergraduate and graduate students are employed by the survey as aides and research assistants. Whenever possible their work forms part of the research for a master's thesis or Ph.D. dissertation. The Minnesota Geological Survey is a potential source of employment and research support in geologically related aspects of the environment and planning.

The Minnesota Geological Survey maintains an inventory of topographic and geologic maps of the state, as well as publications on the state's geology and resources. For further information, call 627-4780.

MINNESOTA LANDSCAPE ARBORETUM

Department of Horticultural Science
College of Agriculture
Peter Olin, Director, P.O. Box 39, Chanhassen, MN 55317; 443-2460

Established in 1958, the Arboretum covers 905 acres of rolling hills with native woods, marshes, a prairie, formal display gardens, and a variety of plant collections. Its programs include the Andersen Horticultural Library with 9,500 non-circulating volumes and a plant locator database with sources for more than 40,000 commercially grown plants, the Research Department which develops cold-hardy fruit and landscape plants, the Horticultural Research Center which has introduced more than 70 cold-hardy fruit varieties, and many informal classes and workshops for children and adults on horticulture, landscape design, and related areas.

MINNESOTA PUBLIC INTEREST RESEARCH GROUP (MPIRG)

Heather Cusick, Executive Director, 2512 Delaware Street S.E., Minneapolis, MN 55414 (campus office, 235 Coffman Union); 627-4035

MPIRG is a nonprofit, nonpartisan organization representing Minnesota college students and working for constructive social change to benefit all Minnesotans. MPIRG activities related to environmental issues include work on energy policy, recycling and waste reduction, forest protection, and alternative modes of transportation.

MPIRG is funded by nearly 30,000 students on nine Minnesota college and university campuses who pay a special fee for its support. It is directed by a board of elected student representatives from the participating institutions. The board holds open meetings at least once a month. All matters of organizational business—from hiring staff, to allocating $400,000 annual budget, to selecting projects for the organization—are handled by the board. Any enrolled, fee-paying student may seek election to the board. Annual elections are held in the spring.

MPIRG employs a full-time staff of fifteen people including attorneys, researchers, organizers and support staff. MPIRG publishes Statewatch two times a year. MPIRG sponsors coursework on advocacy—on campus, in communities, and with the legislature. It also provides numerous internships involving research, organizing, and legislative work. Students work with MPIRG staff in coordinated programs that involve publication of research findings and recommendations for public action, active representation before government agencies, law reform through legislative action, and, where necessary, legal action through courts.

MINNESOTA SEA GRANT

George Spangler, Interim Director, Room 302, 1518 Cleveland Ave N, St. Paul, MN 55108; 625-1253

Minnesota Sea Grant is a statewide program that supports research, extension, and education programs related to Lake Superior and Minnesota's water resources. Programs relate to economic development, pollution, exotic species, fisheries management, and aquaculture. It works to sustain and enhance the aquatic environment for increased productivity through basic research on aquatic systems and ways to control the major threats to those systems.

It publishes a free newsletter, *Seiche*. The newsletter and selected free publications, journal reprints, and publication lists are available from the office by mail or phone.

ST. ANTHONY FALLS HYDRAULIC LABORATORY

Civil and Mineral Engineering
Institute of Technology
Roger Arndt, Director, Mississippi River at 3rd Avenue S.E., Minneapolis, MN 55414; 627-4012 or 627-4010

The St. Anthony Falls Hydraulic Laboratory's focus is on fluid mechanics and water resources engineering and its relationship to the fields of water resources development, including water quality dynamics and hydropower. The Laboratory conducts research on the flow of water in streams, rivers, estuaries, lakes, and man-made pipes, channels, and reservoirs. Transport of sediment, heat, and dissolved substances, as well as natural and artificial water storage, drainage, runoff, and other hydrological processes are part of the research program. The related fields of low speed aerodynamics and wind engineering are also studied.

In its fifty-year history the laboratory staff, comprised of Civil and Mineral Engineering Department faculty, civil service employees, and graduate and undergraduate students, has conducted hundreds of studies on water-related projects locally, nationally, and internationally. Extensive documentation is available through reports and films of the research studies in the Lorenz G. Straub Memorial Library.

The laboratory provides academic and financial assistance to graduate and undergraduate students interested in water resources engineering and related programs.

UNDERGROUND SPACE CENTER

Civil and Mineral Engineering
Institute of Technology
Raymond L. Sterling, Director, 790 Civil and Mineral Engineering Building, 500 Pillsbury Drive S.E., University of Minnesota, Minneapolis, MN 55455; 624-0066

The Underground Space Center is housed within the Department of Civil and Mineral Engineering. The center was founded in November 1977 by the Minnesota Legislature in response to the growing interest in many aspects of underground space utilization.

The goals of the center are to: serve as a focal point for planning and coordination of underground space use; carry out research in areas affecting underground space use; provide an information and referral service for all aspects of underground space utilization, and serve as a focal point for international cooperation or research and information transfer.

During the past fifteen years, research at the Underground Space Center has been conducted on a wide range of topics. Major research areas have included: planning of underground space; legal and regulatory issues; habitability of underground space; life safety in underground buildings; underground storage of food and energy; earth sheltered building technology; subsurface heat transfer; foundation construction and energy use; geomechanics; frost heave action in soils; and energy conservation retrofits to existing buildings.

The Underground Space Center offers two courses on earth-sheltered building design and underground construction engineering; these courses are listed under the Civil Engineering Department's class schedule and in this course guide. Energy use, planning, security, environment, building design, underground excavation, landscaping, building codes, financing, and psychological considerations are covered.

WATER RESOURCES RESEARCH CENTER

College of Natural Resources
Patrick Brezonik, Director, Room 303, 1518 Cleveland Ave. N., St. Paul, MN 55108; 624-9282

The center has responsibility for promoting water resources research at the University of Minnesota and at state and private colleges with funds provided by the Federal Water Resources Research Act of 1964 (most recently reauthorized in 1990). The WRRC also promotes coordination and cooperation among the water research programs of University departments and centers and state and federal agencies throughout the state. The WRRC supports water research activities of faculty primarily through an open competitive grant proposal mechanism. Both fundamental and applied research is supported on physical, biological, economic, social, and political aspects of water resources. Projects generally are related to pressing water issues in the state, such as groundwater contamination, effects of atmospheric contaminants on surface waters, nonpoint source pollution, and impacts of climate change on Minnesota's water resources. Training of scientists for work in water resources fields is an important function of the WRRC. The majority of funds on most projects awarded by the Center are used directly for graduate research assistantships and/or for undergraduate support. In addition, some opportunities exist for student employment on projects conducted directly by the Center.

The center assists in recruiting students and in guiding them into appropriate programs of study. The center has been helpful in developing new courses in various areas of water resources and a new graduate minor program in water resources.

The WRRC publishes and distributes a newsletter called *Minnegram* as well as other informative publications to people throughout the state. The results of research projects are published in technical reports and theses, which the center distributes to scientists and water managers throughout the state and nation. To provide an opportunity for professional people and students working in water resources fields to meet and exchange information, the WRRC organizes and sponsors symposia and conferences on specific water issues. In addition, in cooperation with the Minnesota Environmental Quality Board and other state agencies, the Center sponsors a biennial conference on water resources issues and problems in the state.

V. LIBRARIES

UNIVERSITY LIBRARIES—TWIN CITIES

Research collections that support the courses and programs in the environment are found throughout the libraries which comprise the University Libraries.

In addition to strong collections, the University Libraries offer a full range of reference services and research tools. Databases on CD-ROMs provide free, do-it-yourself computer searching to locate relevant information found in journal articles, newspapers, government documents, statistical data, maps, and other sources. CD-ROMs are housed in libraries by subject focus of collections.

Minneapolis Campus—East Bank

Architecture Library—160 Architecture

Contains material on architecture, design, landscape architecture, and urban planning.

Bio-Medical Library—Diehl Hall

Contains environmentally-related materials in the fields of health sciences, including microbiology, pharmacology, environmental health, and genetics.

Walter Library

Education/Psychology Collections: Contain environmentally-related materials in the fields of education, sports, outdoor recreation, and psychology.

Physical Sciences and Engineering Collections: Contain environmentally-related materials in the fields of chemistry, engineering, geology, mines and metallurgy, physics, and transporation.

Minneapolis Campus—West Bank

Wilson Library

Humanities and Social Sciences Collections: Contain environmentally-related materials in a broad range of social sciences and humanities, including anthropology, economics, environmental policy, geography, international relations, political science, public administration, and sociology.

Also located in Wilson Library are: John R. Borchert Map Library (S-76), Business Reference Service (201), and Government Publications Library (409). The Government Publications Library receives depository publications of the U.S. government, the state of Minnesota, the United Nations, the European Community, intergovernmental agencies, the Metropolitan Council of the Twin Cities, and many publications from foreign governments.

Law Library—Law Building

Contains environmental law materials.

St. Paul Campus

St. Paul Central Library

Contains material on agriculture, biological science, botany, design, ecology, environmental policy, home economics, horticulture, human ecology, and plant science.

Other St. Paul Libraries:

Biochemistry Library	406 Biological Science Ctr.
Entomology, Fisheries and Wildlife Library	375 Hodson Hall
Forestry Library	350 Natural Resources Adm.
Plant Pathology Library	395 Borlaug Hall
Veterinary Medical Library	450 Veterinary Science

NON-UNIVERSITY LIBRARIES

Environmental Conservation Library (ECOL)

Bill Johnston, Librarian, Minneapolis Public Library, 300 Nicollet Mall, Minneapolis, MN 55401; 372-6570

ECOL, a special collection within the Minneapolis Public Library, brings together materials from various subject fields that relate to the physical, environmental, and human impact on planet Earth. ECOL has books, periodicals, newsletters, pamphlets, bibliographies, posters, and government documents relating to such topics as air and water pollution, solid waste, wildlife, conservation of natural resources, land use planning, environmental law, energy resources, and environmental education. ECOL was designated by the Minnesota Legislature as a state center for environmental information and receives publications of many state agencies, including environmental impact statements. ECOL serves as the local public document room for U.S. Nuclear Regulatory Commission materials relating to nuclear power plants in Minnesota. A newsletter, *ECOL News,* is published twice a year and is free to the public.

A large collection of full documents and articles on microfiche are available for use and loan. Entitled *Envirofiche,* they are keyed to the abstract journal *Environment Abstracts.*

Minnesota Department of Health Library

Diane Jordan, Librarian, 717 Delaware Street S.E., Minneapolis, MN 55440; 623-5090

This collection has been developed with the needs of public health professionals in mind and is a specialized library with technical, as opposed to popular, literature. It is a reference collection only and extends no loan privileges except through interlibrary loan. The library subscribes to some 200 periodicals.

Minnesota Department of Public Service (formerly Minnesota Energy and Economic Development Library)

Galina Mogilyansky, Librarian, 900 American Center Building, 150 East Kellogg Boulevard, St. Paul, MN 55101; 296-7952

This research library has a noncirculating collection, although some items may be borrowed through the MINITEX system. The collection contains United States and Minnesota statistics of energy use, Department of Energy reports, and approximately 130 periodicals. There is strong emphasis on energy conservation reports. The library has environmental information on electric power, nuclear power, solar energy, and coal development.

The library also has a collection on economic development issues including trade, high technology, and location of industry, with materials discussing Minnesota and U.S. business conditions.

Minnesota Pollution Control Agency Library

Kathy Malec and Helena Peskova, Librarians, 520 Lafayette Road, St. Paul, MN 55155; 296-7719 or 296-6623

This collection has been developed with the needs of professional pollution control scientists and engineers in mind. It is essentially a technical library with few subprofessional materials. The library extends reference services.

UNIVERSITY OF MINNESOTA

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